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PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XXII. Nos. 303—318.
JANUARY—DECEMBER, 1906.

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LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1907.

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Richard Clay and Sons, Limited,
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LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR 1906.

£5 to W. Barbour: the alkylation of cellulose and polarimetric examination of the products.

£5 to H. W. Bywaters: investigation of the changes occurring in egg-white during incubation of egg.

£20 to A. W. Crossley: the reduction products of chloroketodimethyltetrahydrobenzene.

£10 to G. Dean: redetermination of the atomic weight of nitrogen by estimation of the weight of silver contained in a given weight of pure silver cyanate.

£5 to A. E. Dunstan: the investigation of the viscosity of liquid mixtures.

£5 to C. E. Fawsitt: the viscosity of fluid substances (including metals) and the physico-chemical properties of solids in different states (phases).

£10 to K. Fisher: the synthesis of sylvestrene.

£10 to A. G. Green: the constitution of synthetic colouring matters.

£10 to P. Haas: the action of nitrous acid on dimethyldihydroresorcin and its nitrogen derivatives.

£10 to V. J. Harding: the preparation of an isomeride of camphor from isonitrosocamphor.

£5 to H. Hartley: the physico-chemical properties of mixtures of pyridine and water.

£10 to H. Henstock: $\alpha\alpha\gamma$-trimethyl tricarballylic acids.

£10 to T. M. Lowry: continued studies in dynamic isomerism.

£8 to F. M. Perkin: oxidation of hydrocarbons of the benzene series.

£5 to T. S. Price: electrolytic preparation of dialkyl disulphides.

£10 to R. Robinson: synthesis of some of the more important natural colouring matters.

£12 to J. L. Simonsen: synthesis of pinene.

£5 to J. F. Spencer: electrochemical study of thallium compounds.

£10 to J. J. Sudborough: "Steric Hindrance" and polynitro-compounds.

£15 to J. F. Thorpe: conversion of benzenoid nitriles into derivatives of naphthalene.

£10 to J. F. Thorpe: the action of primary nitriles on *m*-xylylenedinitrile.

£5 to W. B. Tuck: the spectroscopic investigation of phenylhydrazones.

£15 to A. E. H. Tutton: continued study of the relations between crystallographic form and chemical composition.

Total amount granted = £210.

LIST OF FELLOWS ELECTED DURING 1906

Name.	Proposed.	Elected.
Abegg, Richard	November 1st, 1906	December 6th.
Agar, Shelton Gottlieb	May 17th, 1906	July 5th.
Anderson, Robert	June 7th, 1906	,, ,,
Arup, Paul Seidelin	October 18th, 1906	December 6th.
Austin, Percy Corlett	April 5th, 1906	July 5th.
Banner, George Ernest	December 7th, 1905	February 15th.
Barker, Arthur Ernest	,, ,, ,,	,, ,,
Barrett, Ernest	March 15th, 1906	May 3rd.
Bayliss, William Heath	November 1st, 1906	December 6th.
Beckett, Richard Henry	February 15th, 1906	May 3rd.
Bell, William Edward	November 16th, 1905	February 15th.
Berry, Arthur John	May 3rd, 1906	July 5th.
Bethea, Oscar Walter	October 18th, 1906	December 6th.
Birt, Roderick Harold Capper	February 1st, 1906	May 3rd.
Blatchley, Charles Frederick Polwhele	December 7th, 1905	February 15th.
Bogue, Thomas Going Stoney	December 21st, 1905	,, ,,
Bowis, William John	May 3rd, 1906	July 5th.
Braid, Arthur Forbes	December 7th, 1905	February 15th.
Briggs, Richard Victor	January 18th, 1906	,, ,,
Broome, James Spears	October 18th, 1906	December 6th.
Byrom, Thomas Henry	,, ,, ,,	,, ,,
Calam, Harold	May 3rd, 1906	July 5th.
Caldwell, William	December 7th, 1905	February 15th.
Carmichael, John	October 18th, 1906	December 6th.
Carpenter, Percy Henry	,, ,, ,,	,, ,,
Chamberlain, Percy Garratt	March 15th, 1906	May 3rd.
Chrystall, Edwin Rodney	March 1st, 1906	,, ,,
Clarke, Reginald William Lane	December 7th, 1905	February 15th.
Cockburn, Charles Taylor	October 18th, 1906	December 6th.
Conyngham, William Boulton	December 7th, 1905	February 15th.
Cooper, Herbert Reginald	February 15th, 1906	May 3rd.
Cornwall, Reginald de Vere	July 5th, 1906	December 6th.
Courtauld, Stephen Lewis	December 21st, 1905	February 15th.
Coward, Hubert Frank	October 18th, 1906	December 6th.
Crocker, Henry Ernest	July 5th, 1906	,, ,,
Davidson, Charles	February 15th, 1906	May 3rd.
Davson, Archibald Prideaux	October 18th, 1906	December 6th.
Denton, John	May 3rd, 1906	July 5th.
Dickson, William	February 1st, 1906	May 3rd.
Dinwoodie, James Herbert	July 5th, 1906	December 6th.
Drinkwater, Lionel John	April 5th, 1906	July 5th.
Duncan, Robert K.	March 1st, 1906	May 3rd.
Durrans, Thomas Harold	November 16th, 1905	February 15th.

Name.	Proposed.	Elected.
Eaton, Bertie James	May 3rd, 1906	July 5th.
Edgell, Cecil Wyatt-	March 15th, 1906	May 3rd.
Evans, Frederick Watkins	December 7th, 1905	February 15th.
Farmer, Charles George Edgar	November 1st, 1906	December 6th.
Feilmann, Ernest	March 1st, 1906	May 3rd.
Field, Samuel	June 21st, 1906	December 6th.
Fierz, Hans Eduard	December 7th, 1905	February 15th.
Fitzgerald, Anthony Nisbet	October 18th, 1906	December 6th.
Flürscheim, Bernhard	April 5th, 1906	July 5th.
Foucar, James Louis	March 1st, 1906	May 3rd.
Foy, Peter Bertram	March 15th, 1906	,, ,,
Gardner, Edward	February 15th, 1906	,, ,,
Garvey, Richard Godfrey Hamilton	,, ,, ,,	,, ,,
Gibbs, Reginald William Malyon	June 7th, 1906	July 5th.
Glover, Walter Hamis	November 16th, 1905.	February 15th.
Gregory, Thomas William D.	May 17th. 1906	July 5th.
Grindley, Harry Sands	January 18th, 1906	February 15th.
Grubb, David Paton	November 1st, 1906	December 6th.
Gupta, Hem Chandra Dutt	March 1st, 1906	May 3rd.
Hall, Octavius	October 18th, 1906	December 6th.
Hall, Richard John	March 1st, 1906	May 3rd.
Hamer, John	November 1st, 1906	December 6th.
Hanson, H. Norman	October 18th, 1906	,, ,,
Harris, Frederick James	June 21st, 1906.	,, ,,
Hayworth, William Prince	November 16th, 1905.	February 15th.
Hedley, Edgar Percy	April 5th, 1906.	July 5th.
Herty, Charles H.	June 21st, 1906	,, ,,
Hill, Arthur Edwin	April 5th, 1906.	,, ,,
Hills, James Stuart	February 1st, 1906	May 3rd.
Hines, Charles Percy	October 18th, 1906	December 6th.
Hopkins, Frederick Gowland	April 5th, 1906.	July 5th.
Hughes, John Gerard	May 17th, 1906.	,, ,,
Irving, Henry Carlyle	December 21st, 1905.	February 15th.
Jenkinson, Ernest Arthur	May 17th, 1906	July 5th.
Johnston, Archibald McArthur	June 21st, 1906	December 6th.
Jones, Edward Rees	October 18th, 1906	,, ,,
Jones, Llewellyn Thomas	January 18th, 1906	February 15th.
Jones, William Henry Matthews	December 7th, 1905	,, ,,
Ladell, William Richard Simpson	October 18th, 1906	December 6th.
Lattey, William Tabor	February 15th, 1906.	May 3rd.
Le Rossignol, Robert	January 18th, 1906	February 15th.
McCombie, Hamilton	February 15th, 1906.	May 3rd.
McDowall, John	December 21st, 1905.	February 15th.
McIntosh, David	October 18th, 1906	December 6th.
Macdonald, Thomas	April 5th, 1906	July 5th.
Mace, William	January 18th, 1906	February 15th.
Majumdar, Tarak Nath	November 15th, 1906	December 6th.
Martin, Frederick James	June 7th, 1906.	July 5th.
Martin, George Frederick Wesley	December 7th, 1905	February 15th.
Mastin, John	October 18th, 1906	December 6th.

Name.	Proposed.	Elected.
Middleton, Alexander Edmund	November 1st, 1906	December 6th.
Mills, Herbert Arthur	June 7th, 1906	July 5th.
Morris, Arthur Higgs	November 1st, 1906	December 6th.
Mukerjee, Ram Chandra	March 15th, 1906	May 3rd.
Mummery, William Rest	May 17th, 1906	July 5th.
Murray, Thomas Jenkins	February 15th, 1906	May 3rd.
Naylor, George	October 18th, 1906	December 6th.
Newton, Arthur Percival	November 1st, 1906	,, ,,
Oliver, Edgar Gale	February 15th, 1906	May 3rd.
Ormerod, Ernest	February 1st, 1906	,, ,,
Oxland, Charles Harold	October, 18th, 1906	December 6th.
Palmer, Arthur Charles	May 17th, 1906	July 5th.
Parfitt, Samuel	January 18th, 1906	February 15th.
Parkin, John	December 21st, 1905	,, ,,
Pearse, Leonard Edward Beard	June 7th, 1906	July 5th.
Pendlebury, Harold Lawson	April 5th, 1906	,, ,,
Pennymore, Percy George	,, ,, ,,	,, ,,
Perkins, William Hughes	December 21st, 1905	February 15th.
Pickles, Samuel Shrowder	May 17th, 1906	July 5th.
Pitman, John Edmund	December 7th, 1905	February 15th.
Porritt, Benjamin Dawson	November 1st, 1906	December 6th.
Pye, Thomas Ebenezer	June 7th, 1906	July 5th.
Rawles, Walter Hansen	April 5th, 1906	,, ,,
Redgrove, Herbert Stanley	November 1st, 1906	December 6th.
Richardson, Frederic Ion	October 18th, 1906	,, ,,
Richardson, Lawrence George	February 15th, 1906	May 3rd.
Robinson, Reginald Ernest	October 18th, 1906	December 6th.
Rogerson, Harold	December 7th, 1905	February 15th.
Rowsell, Philip Foale	December 21st, 1905	,, ,,
Salmon, Frederick John	June 7th, 1906	July 5th.
Sanyal, Surendra Prasad	May 17th, 1906	,, ,,
Scouller, Walter Daly	March 1st, 1906	May 3rd.
Seaber, Willie Macro	May 17th, 1906	July 5th.
Sen, Gopal Chandra	July 5th, 1906	December 6th.
Senior, John	April 5th, 1906	July 5th.
Shepherd, Arthur Burton	May 3rd, 1906	,, ,,
Shrimpton, John Kirby	November 16th, 1905	February 15th.
Sime, Allan	May 17th, 1906	July 5th.
Simonsen, John Lionel	October 18th, 1906	December 6th.
Smith, Charles	,, ,, ,,	,, ,,
Smith, Frank	December 7th, 1905	February 15th.
Smith, Fred	May 3rd, 1906	July 5th.
Sommerville, David	February 15th, 1906	May 3rd.
Spencer, James Frederick	March 1st, 1906	,, ,,
Sproxton, Foster	February 15th, 1906	,, ,,
Starling, William R. R.	November 1st, 1906	December 6th.
Storey, Francis W.	March 1st, 1906	May 3rd.
Streimer, Emanuel George	April 5th, 1906	July 5th.
Talbot, George Stanley	January 18th, 1906	February 15th
Telling, Harry George	October 18th, 1906	December 6th.
Tempany, Harold Augustine	February 15th, 1906	May 3rd.

Name.	Proposed.	Elected.
Thorne, Emmanuel Isaac	June 21st, 1906	December 6th.
Thornton, Percy Charles	December 7th, 1905	February 15th.
Thorp, Arthur William	January 18th, 1906	,, ,,
Tonkin, Ronald William	December 7th, 1905	,, ,,
Treble, Richard Lumley	April 5th, 1906	July 5th.
Turnbull, Robert Hutchison	,, ,, ,,	,, ,,
Turner, George Augustus	March 1st, 1906	May 3rd.
Walker, Franklin Wilfred	November 16th, 1905	February 15th.
Warren, Richard Alfred	,, ,, ,,	,, ,,
Wastenays, Hardolph	December 21st, 1905	,, ,,
Watson, Frederick William	June 21st, 1906	December 6th.
Watson, John Adam	March 15th, 1906	May 3rd.
Watt, George Gordon	October 18th, 1906	December 6th.
Watt, Henry Edgar	January 18th, 1906	February 15th.
Watts, James Neil	May 17th, 1906	July 5th.
Wechsler, Elkan	December 7th, 1905	February 15th.
West, John Henry	February 1st, 1906	May 3rd.
Wheaton, Harold Joseph	November 16th, 1905	February 15th.
Wiffen, Henry John	February 1st, 1906	May 3rd.
Wightman, Charles	April 5th, 1906	July 5th.
Willett, Herbert William Mills	November 16th, 1905	February 15th.
Willstaetter, Richard	January 18th, 1906	,, ,,
Winther, Chr.	October 18th, 1906	December 6th.
Wolfe, Ernest Edwin	November 16th, 1905	February 15th.
Wortley, Edward Jocelyn	May 17th, 1906	July 5th.
Wren, Henry	May 3rd, 1906	,, ,,
Yates, John William	December 21st, 1905	February 15th.
Young, George	May 3rd, 1906	July 5th.

FELLOWS DECEASED, 1906.

Name.	Elected.	Died.
*Beilstein, Fedor	February 1st, 1883	October 19th, 1906.
Chandler, William H.	February 1st, 1872	November 23rd, 1906.
Claudet, Frederic Just	February 16th, 1852	April 19th, 1906.
Davis, Thomas Sebastian	January 20th, 1876	December 30th, 1906.
Edwards, Walter Henry	December 4th, 1902	January 23rd, 1906.
Foye, Martin Hugh	June 19th, 1884	unknown.
Hambly, Charles Henry Burbridge	February 3rd, 1859	July 10th, 1906.
Hepburn, John Gotch	February 21st, 1853	April 24th, 1906.
Heywood, John Sharp Cromartie	April 3rd, 1848	September 19th, 1906.
Hurst, George H.	December 3rd, 1885	February 5th, 1906.
Lyte, Farnham Maxwell	February 3rd, 1859	March 3rd, 1906.
Marsh, Charles W.	June 16th, 1881	1896.
Miller, Edmund Howd	May 6th, 1897	November 8th, 1906.
Orsman, William James	February 21st, 1884	June 21st, 1906.
Phillips, Benjamin	June 20th, 1889	August 16th, 1905.
Pitman, John Edmund	February 15th, 1906	March 5th, 1906.
Royle, Thomas	March 20th, 1862	June 1st, 1906.
Smith, Fred.	November 20th, 1890	unknown.
Smith, Thomas Davidson	April 21st, 1898	March 3rd, 1906.
Sprengel, Hermann Johann Philipp	December 1st, 1864	January 14th, 1906.
Squire, William Stevens	February 4th, 1858	May 13th, 1906.
Storey, James Ashburner	May 7th, 1891	April 27th, 1906.
Tookey, Charles	January 15th, 1855	January 3rd, 1906.
Tyson, Thomas B.	December 3rd 1885	April 27th, 1906.
Walker, Alexander, Maj.-General	January 16th, 1868	February 21st, 1905.

* Honorary and Foreign Member.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1906.

	Page in Proceedings.	Page in Transactions.
January 18*th*.		
1. The refractive indices of crystallising solutions with especial reference to the passage from the metastable to the labile condition. By Henry Alexander Miers and Florence Isaac..	9	413
2. The effect of constitution on the rotatory power of optically active nitrogen compounds. Part I. By Mary Beatrice Thomas and Humphrey Owen Jones	10	280
3. The determination of available plant food in soil by the use of weak acid solvents. By Alfred Daniel Hall and Arthur Amos	11	205
4. The action of ammonia and amines on diazobenzene picrate. By Oswald Silberrad and Godfrey Rotter	13	167
5. The preparation of bistriazobenzene. By Oswald Silberrad and Bertram James Smart	14	170
6. Gradual decomposition of ethyl diazoacetate. By Oswald Silberrad and Charles Smart Roy	15	179
7. Studies on nitrogen iodide. III. The action of methyl and benzyl iodides. By Oswald Silberrad and Bertram James Smart	15	172
8. Action of bromine on benzeneazo-*o*-nitrophenol. By John Theodore Hewitt and Norman Walker	16	182
9. The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part I. Monoamines, ammonia, aniline, and *p*-toluidine. By Paul Haas	17	187
10. Silicon researches. Part X. Silicon thiocyanate. By J. Emerson Reynolds	17	397
11. Halogen derivatives of substituted oxamides. By Frederick Daniel Chattaway and William Henry Lewis	18	155
12. Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate. By Thomas Stewart Patterson and John Frew	19	332
13. Some reactions and new compounds of fluorine. By Edmund Brydges Rudhall Prideaux	19	316
14. Contributions to the chemistry of the rare earths. Part I. By Mario Esposito	20	—
15. A synthesis of aldehydes by Grignard's reaction. By Gordon Wickham Monier-Williams	22	273
16. The action of ultra-violet light on moist and dry carbon dioxide. By Samuel Chadwick, John Edwin Ramsbottom, and David Leonard Chapman	23	—

	Page in Proceedings.	Page in Transactions.
17. A contribution to the study of stable diazo-compounds. Preliminary note. By Gilbert Thomas Morgan and William Ord Wootton	23	—
18. Triarylsulphonium bases. By Samuel Smiles and Robert Le Rossignol	24	—
19. An improved apparatus for the continuous extraction of liquids with ether. By Richard Sisson Bowman...	24	—

February 1*st.*

	Page in Proceedings.	Page in Transactions.
20. Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates). By Tamemasa Haga	29	240
21. Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives. By Martin Onslow Forster.	31	222
22. The relations between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group. By Alfred Walter Stewart and Edward Charles Cyril Baly	33	489
23. The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones. By Edward Charles Cyril Baly and Alfred Walter Stewart	34	502
24. The relation between absorption spectra and chemical constitution. Part III. The nitroanilines and the nitrophenols. By Edward Charles Cyril Baly, Walter Henry Edwards, and Alfred Walter Stewart.	35	514
25. The action of light on benzaldehydephenylhydrazone. By Frederick Daniel Chattaway	36	462
26. The union of chlorine and hydrogen. By Charles Hutchens Burgess and David Leonard Chapman	37	1399
27. Note on the molecular weight of epinephrine. By George Barger and Arthur James Ewins.	38	—
28. The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds. By James Campbell Brown......	39	311
29. Slow oxidations in the presence of moisture. By Norman Smith	39	473
30. Fischer's salt and its decomposition by heat. By Prafulla Chandra Rây	40	551
31. Action of quinones on *o*-diamines, *o*-nitroaniline, *m*-nitroaniline, and 2-nitro-*p*-toluidine. A preliminary note. By James Leicester	41	—
32. Some oxidation products of the hydroxybenzoic acids. II. By Arthur George Perkin	41	251
34. Contributions to the chemistry of oxygen compounds. Part I. The compounds of tertiary phosphine oxides with acids and salts. By Robert Howson Pickard and Joseph Kenyon	42	262
34. The rapid electroanalysis of metals. Preliminary note. By Henry Julius Salomon Sand	43	—

	Page in Proceedings.	Page in Transactions.
February 15*th.*		
35. Cuprous formate. By Andrea Angel	58	345
36. The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds. By Harold Hartley and Noel Garrod Thomas	59	1013
37. The spontaneous crystallisation of supersaturated solutions. By Harold Hartley	60	—
38. Preparation and properties of some new tropeines. By Hooper Albert Dickinson Jowett and Archie Cecil Osborn Hann	61	357
39. Studies in asymmetric synthesis. IV. The application of Grignard's reaction for asymmetric syntheses. By Alexander McKenzie	61	365
40. *o*-Cyanobenzenesulphonic acid and its derivatives. By A. Jamieson Walker and Elizabeth Smith	62	350
41. The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part II. Diamines.—*m*- and *p*-Phenylenediamines. By Paul Haas	63	387
42. A modification of the volumetric estimation of free acid in the presence of iron salts. By C. Chester Ahlum	63	470
43. The theory of alkaline development, with notes on the affinities of certain reducing agents. By Samuel Edward Sheppard	64	530
44. Resolution of 2 : 3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides. By Allen Neville	64	383
March 1*st.*		
45. Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor. By Thomas Martin Lowry	70	1033
46. The coagulating action of colloids. Part I. By William Porter Dreaper and Alexander Wilson	70	—
47. Studies on optically active carbimides. III. The resolution of α-phenyl-α′-4-hydroxyphenylethane by means of *l*-menthylcarbimide. By Robert Howson Pickard and William Oswald Littlebury	71	467
48. Experiments on the synthesis of the terpenes. Part VIII. Synthesis of the optically active modifications of Δ^3-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene. By Francis William Kay and William Henry Perkin, jun.	72	839
49. Studies in the acridine series. III. The methylation of chrysaniline. By Albert Ernest Dunstan and John Theodore Hewitt	73	482

	Page in Proceedings.	Page in Transactions.
50. Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c. By Thomas Edward Thorpe	73	408
51. Nitrogen halides from camphoryl-ψ-carbamide. By Martin Onslow Forster and Hans Grossmann	74	402
52. The relation of position isomerism to optical activity. VI. The rotation of the menthyl esters of the isomeric chloronitrobenzoic acids. By Julius Berend Cohen and Henry Percy Armes	74	454

March 15th.

	Page in Proceedings.	Page in Transactions.
53. The interaction of well-dried mixtures of hydrocarbons and oxygen. By William Arthur Bone and George William Andrew	78	652
54. The explosive combustion of hydrocarbons. By William Arthur Bone and Julien Drugman	78	660
55. The occurrence of methane amongst the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method. By Paul Haas	81	570
56. Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution. By Philip Wilfred Robertson	82	567
57. The displacement of acid ions. Part I. By Alfred Francis Joseph	82	823
58. Additive compounds of arylamines with aromatic nitro-derivatives. By Charles Loring Jackson and Latham Clarke	83	—
59. Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines. By John Joseph Sudborough and Norman Picton	84	583
60. The relations between absorption spectra and chemical constitution. Part IV. The reactivity of the substituted quinones. By Alfred Walter Stewart and Edward Charles Cyril Baly	85	618
61. The constitution and properties of acyl thiocyanates. By John Hawthorne	86	556
62. A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid. By Harold Rogerson and Jocelyn Field Thorpe	87	631
63. Aromatic sulphonium bases. By Samuel Smiles and Robert Le Rossignol	87	696
64. A new form of calcium chloride tube for combustion By Arthur Edwin Hill	87	—
65. The viscosity of liquid mixtures. Part III. By Albert Ernest Dunstan	89	—
66. The action of phenylpropiolyl chloride on the ketonic compounds. Part II. By Siegfried Ruhemann	89	682

April 5th.

	Page in Proceedings.	Page in Transactions.
67. An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light. By William Henry Perkin, sen.	100	608
68. The rusting of iron. By Gerald Tattersall Moody	101	720
69. The estimation of carbon in soils. By Alfred Daniel Hall, Norman Harry John Miller, and Numa Marmu	103	595
70. Electrolysis of salts of ββ′ dimethylglutaric acid. By James Walker and John Kerfoot Wood	104	598
71. Bromo- and hydroxy-derivatives of βββ′β′-tetramethylsuberic acid. By John Kerfoot Wood	104	604
72. Some new *o*-xylene derivatives. By George Stallard	104	808
73. A new solvent for gold. Preliminary note. By James Moir	105	—
74. The molecular condition in solution of ferrous oxalate. A correction. By Samuel Edward Sheppard and Charles Edward Kenneth Mees	105	—
75 Acetyl and benzoyl derivatives of phthalamide and phthalamic acid. By Arthur Walsh Titherley and William Longton Hicks	106	708
76. The dynamic isomerism of phloroglucinol. By Edgar Percy Hedley	106	730
77. Studies in asymmetric syntheses. V. Asymmetric syntheses from *l*-bornyl pyruvate. By Alexander McKenzie and Henry Wren	107	688
78. 1-Methyl*cyclo*hexylidene-(4)-acetic acid. By William Henry Perkin, jun., and William Jackson Pope	107	—
79. Condensation of benzophenone chloride with *α*- and *β*-naphthols. By George William Clough	109	771
80. The constitution of cærulignone (cedriret). A preliminary note. By James Moir	110	—
81. A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radicle. By Thomas Vipond Barker	111	—
82. Contributions to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another. By Thomas Vipond Barker	112	1122
83. Constitution of salicin. Synthesis of pentamethyl salicin. By James Colquhoun Irvine and Robert Evstafieff Rose	113	814
84. A product of the action of *iso*amyl nitrite on pyrogallol. By Arthur George Perkin and Alec Bowring Steven	113	802
85. A reaction of ellagic and flavellagic acids. By Arthur George Perkin	114	—
86. Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines. By Oliver Charles Minty Davies	114	713

May 3rd.

	Page in Proceedings.	Page in Transactions.
87. The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds. By Edward Charles Cyril Baly, Effie Gwendoline Marsden, and Alfred Walter Stewart	126	966
88. The residual affinity of coumarin as shown by the formation of oxonium salts. By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait	131	863
89. Brazilin and hæmatoxylin. Part VII. Some derivatives of brazilein. By Paul Engels and William Henry Perkin, jun.	132	—
90. The action of tribromopropane on the sodium derivative of ethyl malonate. By William Henry Perkin, jun., and John Lionel Simonsen	133	—
91. Pipitzahoic acid. By James McConnell Sanders	134	—
92. The constitution of the hydroxides and cyanides obtained from acridine, methylacridine, and phenanthridine methiodides. By Charles Kenneth Tinkler	135	856
93. The constitution of ammonium amalgam. By Elizabeth Mary Rich and Morris William Travers	136	872
94. Action of light on potassium ferrocyanide. By Glyn William Arnold Foster	136	912
95. Note on the constitution of cellulose. By Arthur George Green and Arthur George Perkin	136	811
96. Some new derivatives of pinene. By Frederick Peacock Leach	137	—
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LIBRARY RULES.

1. The Library is open for consultation, and for the issue and return of books, daily from 10 a.m. to 6 p.m. (Saturdays 10 a.m. to 2 p.m.); and in the evenings of those days on which the Chemical Society meets.*

2. Fellows are not allowed to have on loan more than *six* volumes at a time, without special permission from the Librarian.

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ADDITIONS TO THE LIBRARY DURING THE YEAR 1906.

A detailed Catalogue of the Alchemical and Early Chemical Books presented to the Society by Sir Henry Enfield Roscoe, D.C.L., LL.D., F.R.S., will be found on pp. 209–233.

Aaron, *C. H.* Assaying. 2 vols. pp. 142, 170. ill. San Francisco 1900.

Abderhalden, *Emil.* Lehrbuch der physiologischen Chemie in dreissig Vorlesungen. pp. vii + 787. Berlin 1906.

Abegg, *Richard.* See **Handbuch der anorganischen Chemie.**

Abel, *J. J.* See **Journal of Biological Chemistry.**

Abney, *Sir William de Wiveleslie.* Instruction in photography. 11th edition. pp. 676. ill. London 1905.

Agricultural Journal of India. Vol. I. Calcutta 1906. (*Reference*).

Aguiar, *Alberto d'.* See **Revista de Chimica.**

Albu, *Albert,* and **Neuberg**, *Carl.* Physiologie und Pathologie des Mineralstoffwechsels nebst Tabellen über die Mineralstoffzusammensetzung der menschlichen Nahrungs- und Genussmittel sowie der Mineralbrunnen und -Bäder. pp. 247. Berlin 1906.

Alexeyeff, *P.* General principles of organic syntheses. Authorised translation with revision and additions by *J. Merritt* **Matthews.** pp. viii + 246. New York 1906.

American Electrochemical Society. Transactions. Vol. I, etc. Philadelphia 1902 +. (*Reference.*)

Aronstein, *L.* See **Stas**, *Jean Servais.*

Aschan, *Ossian.* Chemie der alicyklischen Verbindungen. pp. xlv + 1163. Braunschweig 1905.

Azo, *R. F.* See **Stapleton**, *Henry Ernest.*

Baeyer, *Adolf von.* Gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. 2 vols. pp. cxxxii + 990, 1195. Braunschweig 1905.

Baker, *Richard T.*, and **Smith**, *Henry G.* Some West Australian eucalypts and their essential oils. (From the *Pharm. J.*, 21, 1905.)

Baumert, *Georg*, **Dennstedt**, *M.*, und **Voigtländer**, *F.* Lehrbuch der gerichtlichen Chemie. Band II. Der Nachweis von Schriftfälschungen, Blut und Sperma. pp. x + 248. ill. Braunschweig 1906.

Bayliss, *W. M.* The kinetics of tryptic action. (Reprinted from the *Archives des sciences biologiques*, **11**, 1904.)

Beam, *William.* See **Leffman**, *Henry.*

Benedicks, *Carl.* Umwandlung des Feldspats in Sericit (Kaliglimmer). (From the *Bull. Geol. Inst. Upsala*, **7**, 1906.)

—— Yttriumhaltiger Mangangranat. (From the *Bull. Geol. Inst. Upsala*, **7**, 1906.)

—— Über das Gleichgewicht und die Erstarrungsstrukturen des Systems Eisen-Kohlenstoff. (From *Metallurgie*, **3**, 1906.)

Bergtheil, *Cyril.* See **Bihar Planters' Association.**

Berkenhout, *John.* First lines of the theory and practice of philosophical chemistry. pp. xxiii + 434. London 1788.

Bernthsen, *A.* Kurzes Lehrbuch der organischen Chemie. 9th edition. Edited by *Ernst* **Mohr.** pp. xxi + 638. Braunschweig 1906.

Berthelot, *Marcellin.* Archéologie et histoire des sciences. pp. 377. Paris 1906.

Bertiaux, *L.* See **Hollard**, *A.*

Bevan, *Edward John.* See **Cross**, *Charles Frederick.*

Bihar Planters' Association. Report of the Indigo Research Station, Sirsiah (*under subsidy from the Government of Bengal*) for the year 1905—1906. By *Cyril* **Bergtheil.** pp. 29. Calcutta 1906.

Bio-chemical Journal. Edited by *Benjamin* **Moore** and *Edward* **Whitley.** Vol. I. Liverpool 1906. (*Reference.*)

Biochemische Zeitschrift. Herausgegeben von *E.* **Buchner**, *P.* **Ehrlich**, *C. von* **Noorden**, *E.* **Salkowski**, *N.* **Zuntz.** Redigiert von *C.* **Neuberg.** Band I. Berlin 1906. (*Reference.*)

Blair, *Andrew Alexander.* The chemical analysis of iron. A complete account of all the best known methods for the analysis of iron, steel, pig-iron, iron ore, limestone, slag, clay, sand, coal, coke, and furnace and producer gases. 6th edition. pp. xix + 328. ill. Philadelphia 1906.

Blount, *Bertram.* Practical electro-chemistry. 2nd Edition. pp. xi + 394. ill. London 1906.

—— Recent progress in the cement industry. A paper read before the Society of Chemical Industry on June 11th, 1906. pp. 48.

Böhm, *C. Richard.* Die Darstellung der seltenen Erden. 2 Vols. pp. xxxii + 492, viii + 484. Leipzig 1905.

Bontoux, *Émile.* See **Lewkowitsch**, *Julius.*

Booraem, *John V. V.* Internal energy, a method proposed for the calculation of energy stored within matter. pp. 144. New York 1906.

Borel, *Pierre.* Bibliotheca chimica. Seu catalogus librorum philosophicorum hermeticorum in quo quatuor millia circiter, authorum chimicorum, vel de transmutatione metallorum, re minerali, et arcanis, tam manuscriptorum, quam in lucem editorum, cum eorum editionibus, usque ad annum 1653 continentur. pp. xii + 276. Paris 1654.

Boyle, *Hon. Robert.* New experiments and observations touching cold, or an experimental history of cold, begun. To which are added an examen of antiperistasis, and an examen of Mr. Hobs's doctrine about cold. Whereunto is annexed an account of freezing, brought in to the Royal Society, by the learned Dr. C. Merret, a Fellow of it. pp. lviii + 845 + 54. ill. London 1665.

British Association for the Advancement of Science. Report of the sixth meeting, 1836. London 1837. (*Reference.*)

British Institute of Preventive Medicine. Transactions. First series. London 1897. (*Reference.*)

Brown, *S. E.* A practical chemistry note-book for matriculation and army candidates. pp. 47. ill. London 1906.

Buchner, *E.* See **Biochemische Zeitschrift.**

Carnegie, *Douglas.* Law and theory in chemistry. pp. 222. London 1894.

Caven, *Robert Martin*, and **Lander**, *George Druce.* Systematic inorganic chemistry from the standpoint of the periodic law. pp. xix + 374. London 1906.

Chemisch-technische Untersuchungsmethoden. Edited by *Georg* **Lunge.** Vol. III. pp. xxvii + 1305 + xliv. ill. Berlin 1905.

Church, *Arthur Herbert.* Church's laboratory guide. A manual of practical chemistry . . . specially arranged for agricultural students. Revised and partly rewritten by *Edward* **Kinch.** Eighth edition. pp. xvi + 349. London 1906.

—— Precious stones considered in their scientific and artistic relations. pp. x + 135. ill. London 1905.

Cohnheim, *Otto.* See **Mann**, *Gustav.*

Crookes, *Sir William.* Select methods in chemical analysis (chiefly inorganic). 4th edition. pp. xxiv + 738. ill. London 1905.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 303.

Thursday, January 18th, 1906, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. J. E. Coates, A. Amos, and M. B. Jack were formally admitted Fellows of the Society.

The President announced that the Society had lost a distinguished Fellow in the person of Professor Hermann Johann Philipp Sprengel, Ph.D., F.R.S., who was elected in December, 1864, and died on January 14th, 1906.

It was also stated by the President that the Society was indebted to Sir Henry E. Roscoe, F.R.S., for an important donation to the Library of nearly one hundred alchemical and old chemical works of great interest and value.

Certificates were read for the first time in favour of Messrs.:

Richard Victor Briggs, Sirseah Research Station, Mozufferpore P.O., Bengal, India.
Llewellyn Thomas Jones, B.Sc., Brenig View, Tregaron.
Samuel Parfitt, 33, Partridge Road, Cardiff.
Robert Le Rossignol, B.Sc., 2, Cæsarea Place, Jersey
Arthur William Thorp, 210, Sherborne Road, Yeovil.
Henry Edgar Watt, B.Sc., 19, Summerhill Road, Dartford, Kent.
Richard Willstätter, Ph.D., Bergstrasse 25, Zürich V.

Certificates have been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of :

William Mace, of Hope, Kingston, Jamaica.
George Stanley Talbot, Ocean Island, Sydney, N.S.W.
Harry Sands Grindley, D.Sc., State University, Illinois, U.S.A.

The Council has ordered the following letter and report to be printed in the Journal and Proceedings of the Society :

GOVERNMENT LABORATORY,
CLEMENT'S INN PASSAGE,
STRAND, LONDON, W.C.
10*th November*, 1905.

GENTLEMEN,

I have the honour to transmit to you the Report of the International Committee on Atomic Weights, 1906, to which I have appended the signatures of Professors Moissan and Seubert as desired by them.

It will be seen that the Committee, for the reasons stated in the report, are not prepared to advise any immediate alteration in the values for the atomic weights given in their last report. They recommend, however, in conformity with the desires of the great majority of the Larger Committee, that the values in the table for 1906 be given on the basis of $O = 16$, to the exclusion of those on the basis of $H = 1$.

I am, Gentlemen,
Your obedient Servant,
T. E. THORPE.

The Hon. Secretaries,
The Chemical Society,
Burlington House,
London, W.

Report of the International Committee on Atomic Weights.

During the year 1905 there has been unusual activity in the determination of atomic weights, and some of the work done relates to the most fundamental values. The entire system of atomic weights is thus affected more or less profoundly, and a general revision of the table would seem to be needed within the near future. Neglecting minor investigations, the more important determinations published since our last report are briefly as follows :

Cadmium.—Atomic weight determined by Baxter and Hines

(*J. Amer. Chem. Soc.*, 1905, **27**, 222), by analysis of the chloride. Three measurements of the ratio $CdCl_2 : 2AgCl$ gave in mean Cd = 112·476. Six measurements of the ratio $CdCl_2 : 2Ag$ gave in mean Cd = 112·462. General mean of both series, 112·469; when Ag = 107·93 and Cl = 35·473. As additional determinations are promised, based upon a study of cadmium bromide, a change in the atomic weight of cadmium as given in our table may properly be deferred.

Carbon.—From the ratios published in 1904, relative to the basic acetate and acetylacetonate of glucinum, Parsons (*J. Amer. Chem. Soc.*, 1905, **27**, 1204; *Zeit. anorg. Chem.*, 1905, **46**, 215) has computed the atomic weight of carbon. The values obtained by treating the two ratios algebraically are Gl = 9·112 and C = 12·007. As the latter figure is quite independent of all previous determinations it has distinct corroborative significance.

Chlorine and Sodium.—In a very elaborate investigation upon the atomic weights of chlorine and sodium, Richards and Wells * have shown that the data furnished by Stas are affected by appreciable errors. Ten syntheses of silver chloride gave, in mean, Cl = 35·473 when Ag = 107·93. From ten measurements of the ratio Ag : NaCl, and ten of the ratio AgCl : NaCl, with the foregoing values for silver and chlorine, Na = 23·008. Stas's values are Cl = 35·455 and Na = 23·048.

The results just cited are obviously indirect, for they depend upon the atomic weight of silver. The experiments published by Dixon and Edgar † are therefore of peculiar interest, for they involve the intervention of no intermediate quantities between the atomic weights of chlorine and hydrogen. Hydrochloric acid was directly synthesised from weighed amounts of hydrogen and chlorine, and nine concordant determinations gave, in mean, Cl = 35·195, ± 0·0019, referred to the hydrogen standard. With O = 16, Cl becomes 35·463, a value nearly midway between that found by Stas and the new figure given by Richards and Wells. Considering the difficulties of the work, the agreement between this and the previous investigations is as close as could be reasonably expected.

Gadolinium.—Urbain (*Compt. rend.*, 1905, **140**, 583), from ten analyses of the octohydrated sulphate, finds Gd = 157·23; when H = 1·007 and S = 32·06. This value is more than a unit higher than that given in the table, and is probably more trustworthy.‡

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* Published by the Carnegie Institution of Washington, 70 pp., April, 1905. See also *J. Amer. Chem. Soc.*, 1905, **27**, 459.

† *Chem. News*, 1905, **91**, 263. Memoir read before the Royal Society.

‡ See Eberhard, *Zeit. anorg. Chem.*, 1905, **45**, 374; on the spectroscopic purity of the rare earth oxides studied by Urbain and others.

Iodine.—Baxter has continued his research of 1904 upon the atomic weight of iodine, and has published a second memoir upon this subject (*J. Amer. Chem. Soc.*, 1905, **27**, 876). First, from eight conversions of silver iodide into bromide, by heating in bromine, he found I = 126·985. Two series of measurements, of five experiments in each, of the ratio AgI to AgCl, gave respectively 126·982 and 126·984. Eight determinations of the direct ratio between silver and iodine, weighed separately, gave in mean 126·987. Five determinations of the ratio I : AgI gave 126·983, and four of the ratio Ag : AgI gave 126·989. The average of all six series is I = 126·985; when Ag = 107·93, Cl = 35·473, and Br = 79·955. The last of these antecedent values was checked by a direct comparison of AgBr with AgCl, and the mean of six experiments gave Br = 79·953. The value previously found by Baxter was 126·975 for iodine, and the difference is partly due to his use, in the later investigation, of the new figure obtained for chlorine by Richards and Wells. The iodine work, therefore, is confirmatory of the latter.

Nitrogen.—R. W. Gray, in a preliminary notice (*Proc.*, 1905, **21**, 156), gives the results of his experiments upon nitric oxide. Ten determinations of the density of the gas, corrected by D. Berthelot's formula, give a molecular weight of 30·005, whence N = 14·005. Six analyses of nitric oxide, effected by burning finely-divided nickel in it, gave N = 14·006. The investigation was to be continued farther.

Guye, in an interesting lecture before the Chemical Society of Paris,* has given a complete summary of the researches relative to this atomic weight, which have been conducted by him and his associates at Geneva. He also discusses, somewhat fully, all previous determinations of the constant, and concludes, mainly from the physical evidence, that the atomic weight of nitrogen is not far from 14·01, and that the value 14·04, obtained by Stas, is no longer tenable. Going still farther, he reverses the ordinary gravimetric ratios from which the accepted atomic weight of nitrogen was derived, and, applying to them the new value for N, he deduces the atomic weight of silver. The latter is thus reduced from 107·93 to below 107·89, ranging even as low as 107·871. For these low values Guye cites much confirmatory evidence, which is not to be lightly disregarded. To this point we shall recur later.

Potassium.—Atomic weight redetermined by Archibald (*Trans. Roy. Soc. Canada*, Series 2, **10**, section iii, p. 47) through analysis of the chloride. Four measurements of the ratio AgCl : KCl gave K = 39·139, and four of the ratio Ag : KCl gave 39·140; when Ag = 107·93 and Cl = 35·455. If Cl = 35·473, then K becomes 39·122.

---

* *Bull. Soc. Chim.*, Aug. 5, 1905, with independent pagination. Compare Richards, *Proc. Amer. Phil. Soc.*, 1904, **43**, 116.

Silicon.—W. Becker and J. Meyer (*Zeit. anorg. Chem.*, 1905, **43**, 251; **46**, 45) have determined the atomic weight of silicon by conversion of the chloride into the oxide. Eight determinations were made, and, in sum, 46·82400 grams of $SiCl_4$ gave 16·58236 grams of SiO_2. Hence, with Cl = 35·45, Si = 28·207. With the Richards-Wells value for chlorine, 35·473, Si becomes 28·257. Additional determinations by a different method are promised. This paper is preceded by an essay by Meyer on the calculation of atomic weights (*ibid.*, p. 242), which deserves careful consideration.

Strontium.—From four measurements of the ratio 2Ag : $SrCl_2$, Richards (*Proc. Amer. Acad.*, 1905, **40**, 603) finds Sr = 87·661, when Ag = 107·93 and Cl = 35·473. This confirms the earlier value derived by Richards from experiments upon strontium bromide.

Tellurium.—Gallo (*Atti Accad. Lincei*, 1905, [v], **14**, 23 and 104) have determined electrolytically the ratio between silver and tellurium. From twelve experiments, in mean, Te = 127·61, when Ag = 107·93. Incidentally to this work, as a check upon the method employed, four comparisons between silver and copper were made. In mean, Cu = 63·58.

Thorium.—R. J. Meyer and Gumperz (*Ber.*, 1905, **38**, 817) have attempted to separate ordinary thorium into fractions of different atomic weight, and have failed to verify the observations of Baskerville. The fractions obtained by various processes gave atomic weights varying from 232·2 to 232·7, values which are essentially identical with that given in the table.

From the foregoing summary of results, it becomes evident that a far-reaching series of changes will soon be needed in our system of atomic weights. A change in chlorine or nitrogen implies many other changes in the table, and if the accepted value for silver should be modified the alterations would be most sweeping. The atomic weights of silver, chlorine, and bromine enter into the calculation of nearly all other atomic weights, and form, so to speak, the platform upon which the entire structure stands.

The changes, however, which are suggested at present, are not final. Work is in progress in several laboratories which may confirm or modify many of the accepted values, and until that work is finished, at least so far as the fundamental data are concerned, it is wisest for us to suspend judgment and await developments. Were we to reconstruct the table of atomic weights on the basis of the evidence now before us, we should do it imperfectly, and a new revision would be demanded next year or the year after. Confusion would inevitably follow. Fortunately, the matter is not urgent, for the corrections which now seem desirable are not large, and the existing figures are accurate enough for all ordinary purposes. We therefore recommend that the table for 1905 be continued in use without change during 1906, even although some modifications are theoretically desirable. A year hence we shall be in a better position for a critical adjustment of the data, and no harm can follow from the delay. In accordance with the expressed wish of a majority of the larger committee, we also recommend that the table based upon the oxygen standard be made official. So far as this committee is concerned, the private opinions of its members will be subordinated to the desires of the majority, and the table referred to hydrogen will no longer appear as a part of its report.

For the present, a few suggestions may not be unacceptable, which follow from an examination of the lecture by Guye. Rayleigh, Leduc, Guye, Gray, and others, from their studies of nitrogen and its oxides, have accumulated a mass of strong evidence in favour ot a lower value for nitrogen. The data furnished by Stas, on the other hand, point to the higher value which has heretofore been generally adopted. Can we abandon the one in favour of the other, and accept the new figure without reserve?

On behalf of the new figure for nitrogen, we must admit that the determinations are remarkably concordant, and that they rest upon a direct comparison of the element with oxygen. The Stas values, with their confirmations by other chemists, are also very concordant, but they are indirect. They all rest primarily upon the atomic weights of silver, chlorine, and bromine, and these were connected with oxygen through experiments upon chlorates and bromates. Our whole system of atomic weights, with only a few exceptions, is based to-day upon the analyses of several oxyhalogen salts. Their accuracy is assumed, and all anomalies which appear in determinations based upon other lines of research are commonly ascribed to undiscovered errors. The assumption may be sustained, but it is not yet beyond the reach of criticism.

Consider, for example, the well-known ratio $Ag : AgNO_3 = 100 : 157{\cdot}149$. If $Ag = 107{\cdot}93$, as determined through the analyses of chlorates and bromates, then $N = 14{\cdot}037$, or 14·04 as given in our table. If, on the other hand, $N = 14{\cdot}009$, as given by Guye, Ag becomes 107·881. The difference between the two values for silver evidently represents a difference in our methods of connecting the element with oxygen, the latter being taken as the standard. For each method strong arguments are possible, and for each value other corroborative testimony can be cited. Neither procedure is wholly free from objections, and the final conclusion, therefore, is one of uncertainty. We cannot safely reject either line of evidence, nor can we accept one as surely more exact than the other. Concordant values for silver can be derived from either method of discussion, as

Guye has shown, and through them the entire system of atomic weights is affected.

In this condition of affairs, the position of the committee can only be one of conservatism. It is better to retain the table we have until at least some of the doubts which now affect it have been eliminated. It seems to be essential that the foundations of the atomic weight table should be both broadened and strengthened, and that new lines of research connecting the fundamental values with oxygen shall be investigated. Some work of this kind is already promised from the laboratory of Harvard University, to be carried out by Richards and his colleagues, but that need not exclude other activities. It is to be hoped that a number of investigators may take up the consideration of this problem, and that the methods of attack upon it may be multiplied. The careful study of such salts as the sulphates, carbonates, and nitrates might perhaps be profitable. Whether the organic salts of silver could be utilised for good atomic weight determinations is still uncertain.

F. W. Clarke.
Henri Moissan.
Karl Seubert.
T. E. Thorpe.

1906.

International Atomic Weights.

		O=16.
Aluminium	Al	27·1
Antimony	Sb	120·2
Argon	A	39·9
Arsenic	As	75·0
Barium	Ba	137·4
Bismuth	Bi	208·5
Boron	B	11
Bromine	Br	79·96
Cadmium	Cd	112·4
Cæsium	Cs	132·9
Calcium	Ca	40·1
Carbon	C	12·00
Cerium	Ce	140·25
Chlorine	Cl	35·45
Chromium	Cr	52·1
Cobalt	Co	59·0
Columbium	Cb	94
Copper	Cu	63·6
Erbium	Er	166
Fluorine	F	19
Gadolinium	Gd	156
Gallium	Ga	70
Germanium	Ge	72·5
Glucinum	Gl	9·1
Gold	Au	197·2
Helium	He	4
Hydrogen	H	1·008
Indium	In	115
Iodine	I	126·97
Iridium	Ir	193·0
Iron	Fe	55·9
Krypton	Kr	81·8
Lanthanum	La	138·9
Lead	Pb	206·9
Lithium	Li	7·03
Magnesium	Mg	24·36
Manganese	Mn	55·0
Mercury	Hg	200·0
Molybdenum	Mo	96·0
Neodymium	Nd	143·6
Neon	Ne	20
Nickel	Ni	58·7
Nitrogen	N	14·04
Osmium	Os	191
Oxygen	O	16·00
Palladium	Pd	106·5
Phosphorus	P	31·0
Platinum	Pt	194·8
Potassium	K	39·15
Praseodymium	Pr	140·5
Radium	Rd	225
Rhodium	Rh	103·0
Rubidium	Rb	85·5
Ruthenium	Ru	101·7
Samarium	Sm	150·3
Scandium	Sc	44·1
Selenium	Se	79·2
Silicon	Si	28·4
Silver	Ag	107·93
Sodium	Na	23·05
Strontium	Sr	87·6
Sulphur	S	32·06
Tantalum	Ta	183
Tellurium	Te	127·6
Terbium	Tb	160
Thallium	Tl	204·1
Thorium	Th	232·5
Thulium	Tm	171
Tin	Sn	119·0
Titanium	Ti	48·1
Tungsten	W	184
Uranium	U	238·5
Vanadium	V	51·2
Xenon	Xe	128
Ytterbium	Yb	173·0
Yttrium	Yt	89·0
Zinc	Zn	65·4
Zirconium	Zr	90·6

Of the following papers, those marked * were read:

*1. "The refractive indices of crystallising solutions with especial reference to the passage from the metastable to the labile condition." By Henry Alexander Miers and Florence Isaac.

The authors found that the refractive index of a strong solution of sodium nitrate, measured at intervals while the liquid cools, rises to a maximum value and then falls, crystals appearing before the maximum is reached. If the solution is stirred during the process, the fall is very rapid and is accompanied by a profuse shower of crystals. Other solutions (for example, alum, sodium chlorate, sodium thiosulphate, ammonium oxalate) behave in the same way. There are always two periods of crystallisation: a first, in which a few crystals are growing gradually; a second, in which many crystals appear spontaneously; so that in the latter the increase of index due to cooling is more than compensated by the decrease due to weakening of the solution. The authors regard these as being undoubtedly the metastable and labile states. This view is confirmed by the behaviour of the same solutions enclosed in sealed tubes and shaken continuously; if the salt is completely dissolved, they cannot be made to crystallise until they have assumed a temperature corresponding to the maximum refractive index. By means of auxiliary experiments, the refractive indices are interpreted as concentrations, and each series of observations is expressed as a curve with concentrations for ordinates and indices for abscissæ; the maximum points of the curve lie on a new curve, the "supersolubility curve" denoting the limit between the metastable and labile conditions; the same curve is given by the temperatures at which different solutions yield crystals when shaken in sealed tubes; it shows the highest temperature at which any given supersaturated solution can crystallise spontaneously. It is necessary in the case of sodium chlorate to employ friction as well as motion, by enclosing some insoluble substance in the tube, in order to make the crystals appear as soon as the supersolubility curve is reached.

In the experiments in open vessels, the refractive index is measured by means of a totally reflecting glass prism immersed in the liquid; the crystals which appear before the labile state is reached are doubtless introduced with the dust of the air, or are due to evaporation and cooling at the edges and surface of the liquid, which reduces the solution locally to the labile state.

DISCUSSION.

Dr. TUTTON said that it appeared to him that these interesting experiments lead to two important results. Firstly, that determinations of the refractive index of highly concentrated solutions afford valuable indications of the limits of the so-called "labile" and "metastable" conditions, and a new means of exploring the region of supersaturation. Secondly, that this new method of research may be of value in cases of dimorphism, where one of the forms only is commonly obtained, by throwing some light on the reasons for the predisposition to crystallise in that particular form rather than in the other.

Sir WILLIAM RAMSAY asked whether Professor Miers had made any experiments on the condition of water cooled to below 4° from a high temperature, and produced from melted ice, but not allowed to rise above 4°. Experiments made by Mr. Wilsmore in his laboratory had failed to show any difference in density of different specimens of water thus prepared; but he understood that Dr. Chichester Bell had been successful in detecting different values for γ, the ratio of the specific heats at constant volume and constant pressure, in two such specimens of water; γ was determined by an acoustical method.

Mr. PICKERING said that the authors should be congratulated on having obtained a method of studying solutions at that critical period of their existence when crystallisation is occurring, and he suggested that it might be of advantage to study pure liquids in the same way.

In reply to a question from Prof. Armstrong, Prof. MIERS said that the experiments reveal a state of the solution in which a sudden access of spontaneous crystallisation occurs, and this condition is indicated by the term "labile." He hoped to extend the experiments to water and other pure substances.

*2. "The effect of constitution on the rotatory power of optically active nitrogen compounds. Part I." By Mary Beatrice Thomas and Humphrey Owen Jones.

The resolution of a set of optically active nitrogen compounds and the examination of the rotatory power of their salts in dilute aqueous solution have been made in order to find the rotatory power of the ions. This property of the ions is free from many of the disturbing influences such as molecular association and nature of solvent, which affect the rotatory power of non-electrolytes, and render comparable results so difficult to obtain with this class of compound.

Relations between rotatory power and constitution ought therefore to become more evident in the case of ions than of complete molecules.

Two homologous series, each consisting of five compounds, were chosen for examination; in one series, three of the hydrogen atoms in the ammonium ion are replaced by the phenyl, methyl, and allyl groups, whilst the fourth atom of hydrogen is replaced successively by the ethyl, *n*-propyl, *iso*propyl, *iso*butyl, and *iso*amyl groups; in the other series, the phenyl, methyl, and benzyl groups are present with the same five aliphatic groups. The ethyl compound of the latter series has already been described by one of us, and Wedekind has resolved the *n*-propyl and *iso*butyl compounds. The compounds originally resolved by Pope and Peachey, namely, the phenylbenzylmethylallylammonium salts, fall naturally into both these series.

The following are the values of $[M]_D$ for the ions at 15°:

Phenylmethylallyl series. Ethyl 16°, *n*-propyl 106°, *iso*propyl 1 03°, *iso*butyl 55°, *iso*amyl 18°, benzyl 167°.

Phenylmethylbenzyl series. Ethyl 19·4°, *n*-propyl 299°, *iso*propyl 398°, *iso*butyl 323°, *iso*amyl 287°.

In all cases examined, the value of $[M]_D$ for the basic ion is diminished slightly with increasing temperature between 10° and 50°.

In both series there is a well-marked maximum of rotatory power at the second member of the series, the propyl or *iso*propyl compound; in the allyl series, the rotatory power of these two compounds is almost identical, but in the benzyl series the propyl compound occupies quite a different position.

The application of Guye's hypothesis to the case of nitrogen gives an expression for the rotatory power of the compound in terms of the masses of the substituting groups which does not account for the results in an entirely satisfactory manner.

In those cases where the active iodide could be recovered its rotatory power was examined in solution in alcohol and in chloroform. The rotatory power was always greater in chloroform than in alcohol, and the iodides invariably underwent racemisation in chloroform solution with very different velocities.

*3. "The determination of available plant food in soil by the use of weak acid solvents." By Alfred Daniel Hall and Arthur Amos.

The authors have investigated the effect of repeating the attack of weak acid solvents on soils of known history derived from the Rothamsted experimental plots. After the first extraction, the soil is washed and again extracted with the same solvent, the process being repeated several times. The solvents employed were water charged with carbon dioxide and a 1 per cent. solution of citric acid.

The first extraction does not remove the whole of the phosphoric acid capable of going into solution in the given solvent, the reaction is a reversible one, and a position of equilibrium is attained between the phosphoric acid in solution and the bases in the soil.

With carbon dioxide and water, the position of equilibrium is approximately constant for successive extractions and is characteristic of the manurial history of the soil. With dilute citric acid, the phosphoric acid going into solution falls for the first four or five extractions and then becomes approximately constant. In the case of the Rothamsted soils, which have been continuously manured with superphosphate, the phosphoric acid going into solution decreases logarithmically, indicating that the amount dissolved is proportional to the active mass of a particular compound present in the soil, six-tenths of which become dissolved at each extraction. The total quantity of this compound is equal to the phosphoric acid supplied as manure during the last 50 years, less that which has been removed in the crop.

Soils which have received more varied compounds of phosphoric acid as manure do not show the same regular decrement in the amounts passing into solution, indicating the presence in the soil of a number of compounds of phosphoric acid of differing solubility.

The investigation lends no support to the theory that all soils establish in the soil water a solution of phosphoric acid of approximately the same composition and independent of the fertilisers the soil receives.

DISCUSSION.

Dr. **Dyer** said the paper was one of much interest; for whilst in his original examination of these soils he had, by one extraction only with citric acid, found in the surface soil the greater part of the calculated accumulation of phosphoric acid due to the manuring, the authors had now, by their supplementary extractions with the same reagent, discovered the remainder almost with the accuracy of an accountant's balance sheet—except in the case of the dunged plots. In three cases, the earlier investigation showed that some of the phosphoric acid had gone down into the lower depths of the subsoil, and, furthermore, the actual quantity of phosphoric acid added in the dung could only be vaguely guessed. It was satisfactory to hear that the authors still considered that for practical analytical purposes one extraction sufficed.

Mr. **Pickering** asked whether the influence of the volume of solution used—which would mean a variation in the proportions of citric acid to soil—had been investigated, also whether the effect of pulverisation of the soil had been examined, for he had found that the amount of potash and iron dissolved by citric acid from a soil depended largely on the degree of fineness to which the soil had been reduced.

In reply, Mr. Hall said that in all cases the amount of citric acid solution had been kept constant, 1 litre to 100 grams of the soil. Soil which passed the 3 mm. sieve was used without any grinding, but as there were other reasons for supposing that the soil phosphates were almost wholly found on the outside of the soil particles, grinding should not make much difference to the phosphoric acid results.

*4. "The action of ammonia and amines on diazobenzene picrate." By Oswald Silberrad and Godfrey Rotter.

When diazobenzene picrate is acted on by ammonia gas, it rapidly loses the characteristics of a diazo-salt and forms a dark red product.

Two possibilities presented themselves, namely: (1) the formation of ammonium picrate, accompanied by further reactions between the diazo-complex and the excess of ammonia; (2) an intramolecular transformation of the diazo-picrate to trinitrobenzeneazophenol, somewhat analogous to the diazoaminobenzene transformation.

The intense red colour of the product appeared to lend some probability to the latter assumption, but an examination of the reaction completely disproved the presence of azo-compounds. The products proved to consist mainly of ammonium picrate, and diphenylamine, aniline, and phenol were also detected. Thus, the course of the reaction is evidently represented by the equations: $2C_6H_5 \cdot N_2 \cdot O \cdot C_6H_2(NO_2)_3 + 3NH_3 = (C_6H_5N_2)_2NH + 2NH_4 \cdot O \cdot C_6H_2(NO_2)_3$; $(C_6H_5N_2)_2NH = (C_6H_5)_2NH + 2N_2$; $(C_6H_5N_2)_2NH + H_2O = C_6H_5 \cdot NH_2 + C_6H_5 \cdot OH + 2N_2$.

Other compounds occurred in small quantities as the result of secondary reactions. When treated with aniline, diazobenzene picrate gives rise to aniline picrate and aminoazobenzene; the latter compound evidently resulted from a transformation of diazoaminobenzene; thus, in this case, the reaction takes place as follows: $C_6H_5 \cdot N_2 \cdot O \cdot C_6H_2(NO_2)_3 + 2C_6H_5 \cdot NH_2 = C_6H_5 \cdot N_2 \cdot NH \cdot C_6H_5 + C_6H_5 \cdot NH_3 \cdot O \cdot C_6H_2(NO_2)_3$.

Discussion.

Dr. Morgan stated that in conjunction with Mr. Wootton he had studied the picrates of diazo-compounds, and especially the stable product derived from *p*-aminobenzanilide (see p. 23). This compound was precipitated even in strongly acid solution and was, therefore, in all probability a diazonium derivative. They had not detected *syn*- and *anti*-isomerism in this series. It would be interesting to know whether the more explosive diazobenzene picrate was a diazo-compound or a diazonium salt.

In reply, Dr. Silberrad said that the comparative stability of diazobenzene picrate was remarkable considering its constitution, but, nevertheless, he regarded it as a true diazonium salt. Under these conditions, it seemed improbable that *syn*- and *anti*-derivatives could be prepared, which was in accord with Dr. Morgan's observations on similar compounds.

*5. "The preparation of bistriazobenzene."
By Oswald Silberrad and Bertram James Smart.

The explosive properties of bistriazobenzene have hitherto precluded the verification of its composition by analysis; for this reason, a reinvestigation of the compound has been undertaken, and at the same time the method for its preparation has been somewhat modified.

Griess (*Ber.*, 1888, **21**, 1559) took the oxamic acid of *p*-phenylenediamine as the starting point for the preparation of this compound; in the present work, however, it has been found advantageous to proceed from *p*-aminoacetanilide. The successive steps of the preparation are seen from the following series of intermediate products: *p*-aminoacetanilide, acetyl-*p*-aminodiazobenzene perbromide, *p*-aminotriazobenzene, *p*-triazodiazobenzene perbromide, bistriazobenzene.

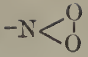
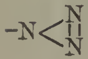
Acetyl-p-*aminodiazobenzeneperbromide*, $CH_3{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}N_2Br_3$, crystallises in small, yellow plates (m. p. 126°) with decomposition.

p-*Aminotriazobenzene*, $NH_2{\cdot}C_6H_4{\cdot}N_3$, was prepared by the hydrolysis of acetyl-*p*-aminotriazobenzene with caustic potash, previously unsuccessfully attempted by Rupe and von Majewski (*Ber.*, 1900, **33**, 3406).

Bistriazobenzene, $N_3{\cdot}C_6H_4{\cdot}N_3$ (m. p. 83°) explodes on heating; its analysis was, however, successfully carried out under diminished pressure, and gave results which agreed with the above formula.

DISCUSSION.

Dr. FORSTER inquired whether *p*-bistriazobenzene has a distinctive odour, because he had noticed that *m*- and *p*-nitrophenylazoimides have a faint odour of anise, which is more marked in the case of *p*-tolylazoimide and *p*-chlorophenylazoimide, whilst in the case of *p*-methoxyphenylazoimide the odour is comparable with that of anethole itself, being less sweet and more pungent than the perfume of the last-named substance. Curiously enough, *o*-nitrophenylazoimide is odourless.

In reply, Dr. SILBERRAD said that he had noticed an anise-like odour, but considered the smell more similar to that of a nitro-compound, and suggested that this might be regarded as an argument in favour of the formula  $-\mathrm{N}<\overset{\mathrm{O}}{\underset{\mathrm{O}}{|}}$ for nitro-derivatives analogous to  $-\mathrm{N}<\overset{\mathrm{N}}{\underset{\mathrm{N}}{\|}}$ of triazo-compounds.

*6. "Gradual decomposition of ethyl diazoacetate." By Oswald Silberrad and Charles Smart Roy.

When ethyl diazoacetate is exposed to light at the ordinary temperature, a gradual evolution of nitrogen occurs, and after the space of several years, thick, colourless, rhombic crystals resembling cane sugar gradually make their appearance. On examination, this compound proved to be the triethyl ester of 4 : 5-dihydro-3 : 4 : 5-pyrazoletricarboxylic acid.

Subsequent work showed that the same compound can readily be produced by warming ethyl diazoacetate with copper dust. In both cases, the reaction is evidently due to the intermediate formation of fumaric or maleic esters.

This view is confirmed by the work of Buchner and Witter, who prepared the trimethyl ester by the action of the corresponding ester of fumaric or maleic acid on methyl diazoacetate (*Annalen*, 1895, **273**, 239).

*7. "Studies on nitrogen iodide. III. The action of methyl and benzyl iodides." By Oswald Silberrad and Bertram James Smart.

The action of methyl iodide.—Previous experiments by Stahlschmidt (*Poggendorff's Ann.*, 1863, **119**, 421) on the interaction of nitrogen iodide with methyl iodide led him to represent the reaction by the following equation: $2\mathrm{NI}_3 + 6\mathrm{CH}_3\mathrm{I} = \mathrm{N(CH}_3)_4\mathrm{I}_5 + \mathrm{NH}_4\mathrm{I} + 2\mathrm{CHI}_3$. Since the formula here assumed for nitrogen iodide is not in accord with that proved by Chattaway (*Proc.*, 1899, **17**, 20; *Amer. Chem. Soc.*, 1900, **23**, 363, &c.), or with the constitution $\mathrm{NI}_3{:}\mathrm{NH}_3$, established by one of the authors (Silberrad, Trans., 1905, **87**, 55 and 66), renewed experiments have been carried out on the above reaction. The formation of tetramethylammonium pentaiodide as observed by Stahlschmidt was confirmed in the present work, and its nature established by its preparation from tetramethylammonium iodide and iodine. Iodoform was not, however, as he believed, a product of the reaction between nitrogen iodide and methyl iodide, but resulted from the alcohol, present in his experiments. In the present work, alcohol was excluded; the nitrogen iodide was prepared from ammonia and iodine chloride and was allowed to react with excess of methyl iodide under water. The products found were tetramethylammonium pentaiodide, ammonium iodide and iodate, and free iodine. The quantities of all these products were determined and the reaction was proved to proceed almost quantitatively according to the following equation:

$$6N_2H_3I_3 + 24CH_3I + 3H_2O = 6N(CH_3)_4I_5 + 5NH_4I + 3I_2 + NH_4{\cdot}IO_3.$$

No compounds corresponding to Stahlschmidt's di-iodomethylamine or butyric acid were produced.

Action of benzyl iodide.—This iodide was found to react readily with moist nitrogen iodide. The nature of products, however, depends on the proportion of benzyl iodide taken, bright green or garnet-red crystals being deposited according to the conditions of the experiment. These proved both to be periodides of tribenzylamine.

Tribenzylammonium pentaiodide, $N(C_7H_7)_3HI_5$, which forms bright green crystals melting at 121—122°, is sparingly soluble in alcohol, and undergoes a slight decomposition on recrystallisation.

Tribenzylammonium di-iodide, $N(C_7H_7)_3HI_2$, crystallises in garnet-red prisms melting at 115—116°; it dissolves more readily in alcohol than the pentaiodide, and can be more easily obtained in the crystalline condition.

The pentaiodide can be readily converted to the red di-iodide by the partial abstraction of its iodine by shaking with potassium iodide solution. Conversely, the di-iodide can be converted into pentaiodide by treatment with alcoholic iodine. Both compounds can also be obtained direct from tribenzylamine by the addition of the required quantity of iodine to the iodide of the base.

*8. "Action of bromine on benzeneazo-*o*-nitrophenol."

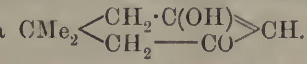
By John Theodore Hewitt and Norman Walker.

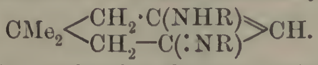
By the action of bromine on 4-benzeneazo-2-nitrophenol in presence of glacial acetic acid and fused sodium acetate, the 6-hydrogen atom is replaced. The constitution of the resulting compound, which when pure melts at 154·5—155°, was confirmed by fission with excess of fuming nitric acid. The resulting *p*-nitrophenyldiazonium nitrate was isolated by conversion into *p*-nitrobenzeneazo-β-naphthol, whilst 1·5 grams of 2-bromo-4 : 6-dinitrophenol, melting before purification at 116° (uncorr.), were obtained instead of the theoretical amount of 1·6 grams from 2 grams of the azophenol. Körner gives the melting point of bromodinitrophenol as 118°.

The following derivatives of benzeneazobromonitrophenol have been analysed: *sodium* and *potassium* salts, *acetyl* derivative (m. p. 137°), and *benzoyl* derivative (m. p. 131°). 4-p-*Tolueneazo*-2-*nitro*-6-*bromophenol* was prepared in a similar manner from *p*-tolueneazonitrophenol;

it melts at 161°. Fuming nitric acid furnishes 2-bromo-4 : 6-dinitrophenol as a product of fission ; its *acetyl* derivative melts at 124°, the *benzoyl* derivative at 129°.

*9. "The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part I. Monoamines, ammonia, aniline, and *p*-toluidine." By Paul Haas.

Dimethyldihydroresorcin reacts with ketonic reagents as a diketone; in most of its other reactions, however, it behaves as a hydroxyketone having the formula  $CMe_2<\begin{array}{l}CH_2\cdot C(OH)\\CH_2\text{——}CO\end{array}>CH$. In this form, it condenses with a single molecule of a primary amine by the elimination of water between the hydroxyl group and the amino-hydrogen, giving rise to a secondary amine. This replacement of the hydroxyl group by a basic group $-NHR$ caused the remaining ketonic oxygen to become hydroxylic, as shown by the fact that the new substance gives a colour reaction with ferric chloride and does not react with ketonic reagents; when, however, the basic substituting group is rendered more acid by acetylation, the resulting compound no longer gives any coloration with ferric chloride and condenses with semicarbazide, showing that the oxygen atom has become ketonic.

Chloroketodimethyltetrahydrobenzene, unlike dimethyldihydroresorcin, reacts at once with two molecules of a primary amine, giving rise to the hydrochloride of a mixed secondary and tertiary base having the formula  $CMe_2<\begin{array}{l}CH_2\cdot C(NHR)\\CH_2-C(:NR)\end{array}>CH$. Bases of this type may also be prepared by condensing the mono-substituted derivatives, obtained by the action of dimethyldihydroresorcin on the amine, with a second molecule of the same amine in the presence of zinc chloride.

10. "Silicon researches. Part X. Silicon thiocyanate."
By J. Emerson Reynolds.

The author found that silicon thiocyanate, $Si(SCN)_4$, is best prepared by prolonged digestion of pure lead thiocyanate in a benzene solution of silicon tetrachloride. An excess of the lead salt must be used, as the latter exchanges but one of its two thiocyanogen groups for chlorine, forming the yellow, crystalline compound $PbCl(SCN)$, silicon thiocyanate remaining in solution. The latter compound is obtained in fine white crystals, when most of the benzene is removed by distillation; but if any moisture is present the crystals become yellow owing to decomposition. This method of preparing the thiocyanate gives a much better product than Miquel's (*Ann. Chim. Phys.*, 1877, [v], **11**, 343), in which the materials are heated to about 400°, as in this investigator's process charring results, and an impure substance is obtained.

The pure thiocyanate melts at 143·8° (corr.) and boils at 314·2° (corr.), distilling without decomposition.

The chief interest attaches to the constitution of the compound, as the somewhat analogous phosphorus "trithiocyanate" has been shown by A. E. Dixon (*Trans.*, 1901, **79**, 541) to exhibit "a form of tautomerism," in some cases acting as $P(NCS)_3$ and in others as $P(SCN)_3$.

The author has compared silicon thiocyanate with the phenylamide, $Si(NH{\cdot}C_6H_5)_4$, described in Part V of this series of papers, and has examined several interactions of the thiocyanate with aniline and other substances, and concludes from the results that it is correctly represented by the expression $Si(SCN)_4$.

11. "Halogen derivatives of substituted oxamides."

By Frederick Daniel Chattaway and William Henry Lewis.

The action of the halogens on substituted oxamides has been little studied, and the description given of the substances formed is not very satisfactory, as the crude products obtained were not subjected to any process of purification. The action of chlorine on oxanilide has been studied and a number of substituted oxanilides has been prepared in a simpler way in order to compare them with the foregoing products

The usual product of the chlorination of oxanilide is a mixture of *s*-di-*p*-chlorophenyloxamide and of its *s*-dichloroamino-derivative.

When aniline or a substituted aniline is heated with ethyl oxalate, a symmetrical disubstituted oxamide on the ethyl ester of a substituted oxamic acid is formed according as the aniline or the ethyl oxalate is in excess.

The symmetrical chlorophenyloxamides, which are almost insoluble in ordinary solvents, crystallise well from nitrobenzene, in which on heating they readily dissolve.

The following compounds were described: s-*di*-p-*chlorophenyloxodichloroamide*, colourless rhombs (m. p. 169°); *ethyl* p-*chlorophenyloxamate*, colourless plates (m. p. 155°); p-*chlorophenyloxamide*, colourless needles (m. p. 241°); s-*di*-p-*chlorophenyloxamide*, colourless, thin plates (m. p. 288°); *ethyl* 2:4-*dichlorophenyloxamate*, colourless, hair-like prisms (m. p. 119°); 2:4-*dichlorophenyloxamide*, colourless, hair-like crystals (m. p. 234°); s-*di*-2:4-*dichlorophenyloxamide*, colourless, slender prisms (m. p. 276°); s-*dimethyloxodichloroamide*, colourless, slender prisms (m. p. 37°); s-*diethyloxodichloroamide*, pale yellow, viscid liquid which decomposes on heating; s-*dimethyloxodibromoamide*, pale yellow, flattened prisms (m. p. 95°); s-*diethyloxodibromoamide*, pale yellow plates (m. p. 82°).

12. "Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate." By Thomas Stewart Patterson and John Frew.

Menthyl benzenesulphonate and menthyl naphthalene-β-sulphonate have been prepared by the pyridine method. The former crystallises from alcohol in silky needles melting at 80°, the latter separates from alcohol in solid, opaque crystals melting at 114—114·5°. The compounds themselves decompose on continued heating at or above the melting point, so that their rotations have been determined in ethyl alcohol, benzene, and nitrobenzene. The chief points of interest are as follows: (1) there is considerable variation of rotation with change of solvent. (2) The values of $[M]_D$ for the β-naphthalene compound are consistently lower than for the benzenesulphonate in a given solvent. (3) The solvents, however, do not exert proportionate influences on the rotations of the two compounds. (4) Menthyl benzenesulphonate has a lower molecular rotation than menthyl benzoate by about 56°, and menthyl naphthalene-β-sulphonate a lower rotation than menthyl β-naphthoate by about 113°. (5) As regards the influence of temperature change on the rotations of these compounds in solution, it was found that the greater the rotation produced by a solvent the more rapid was its diminution with rise of temperature. The molecular rotations in dilute solution seem to tend at higher temperatures towards a common value of about $-170°$.

13. "Some reactions and new compounds of fluorine." By Edmund Brydges Rudhall Prideaux.

The fluorine was prepared by the electrolysis of anhydrous hydrogen fluoride contained in a copper vessel (Moissan, "Le Fluor et ses Composés"). In every case when the gas was analysed it was found to contain oxygen, and special experiments proved that this oxygen was produced at the anode even after the current had passed for a considerable time.

Liquid fluorine has no solvent or chemical action on iodine. The colourless iodine fluoride was analysed by a volumetric method, and four concordant percentages of iodine confirmed the formula IF_5 established by Moissan (*Compt. rend.*, 1902, **135**, 563) from the results of gravimetric analysis.

Bromine fluoride was prepared for the first time; analyses carried out by a gravimetric method led to the formula BrF_3. Liquid fluorine has neither solvent nor chemical action on solid bromine.

Gaseous fluorides of selenium and tellurium were prepared by the direct combination of the elements in the cold. The formulæ of these gases were proved to be SeF_6 and TeF_6 by determinations of their densities. Analysis of TeF_6 also showed it to have this formula. These gases are colourless and easily condensable by moderate cold or pressure to white, crystalline solids and colourless liquids respectively. Tellurium hexafluoride has an unpleasant odour and decomposes water slowly at 15° ; selenium hexafluoride does not decompose water at 15°.

The vapour pressure curve of SF_6 was determined for comparison with those of SeF_6 and TeF_6. The three curves resemble one another closely. In the case of SF_6 and SeF_6, the melting points lie above the temperatures at which the vapour over the solid attains a pressure of 760 mm., whilst in the case of TeF_6 the melting point lies just below the boiling point. The critical temperatures of the liquefied gases rise in the order SF_6, SeF_6, TeF_6.

The molecular volumes at temperatures equally removed from the melting points were found to be very nearly the same.

The refractivities of the three compound gases bear no simple additive relation to those of their constituent elements.

The refractivities *minus* a constant are directly proportional to the densities of the gases.

14. "Contributions to the chemistry of the rare earths. Part I."

By Mario Esposito.

The methods advocated for the separation of cerium, lanthanum, and "old didymium" have been examined comparatively with the following results.

Preparation of the Material.—Rather more than half a kilogram of finely-powdered Swedish cerite was mixed into a paste with water, and 375 grams of concentrated sulphuric acid were gradually added. Considerable evolution of heat took place and the mass swelled up somewhat. The excess of acid was then removed by heat, and the cold white or grey mass was thrown in small portions into 5 litres of ice-cold water. The silica was removed by filtration and a current of hydrogen sulphide was passed through the solution to precipitate any arsenic, molybdenum, bismuth, copper, or lead which might be present. To the filtrate, oxalic acid was added, which precipitated all the ceria, lanthana, and "didymia" along with lime and traces of the yttrium group which are present in cerite (Brauner, *Trans.*, 1883, **43**, 278). The oxalates were thoroughly washed and dried.

Methods of Separation.—(1) The first method tried was that originally proposed by Watts (*Quart. Journ. Chem. Soc.*, 1850, **2**, 131). Some of the reddish-brown oxide prepared by igniting the foregoing oxalates was boiled for several hours with a strong ammonium chloride solution until no more dissolved. The reddish-brown, insoluble ceria was washed with ammonium chloride solution and dissolved by boiling with alcohol and strong hydrochloric acid. The solution showed strong "didymium" absorption bands, and probably also contained lanthanum.

(2) Brauner's basic nitrate method (*Trans.*, 1883, **43**, 278; 1885, **47**, 879) gave fairly good results, but some of the cerium remains in solution.

(3) Popp's method (*Annalen*, 1864, **131**, 360), which consists either in boiling a neutral solution of the chlorides with sodium acetate and sodium hypochlorite or in passing a current of chlorine through a solution mixed with sodium acetate, gives good results on a small scale, but is inconvenient with larger quantities.

(4) Although the same objection applies to Mosander's method with caustic potash and chlorine (*Poggendorff's Ann.*, 1843, **60**, 297), very pure ceria can thus be obtained.

(5) For ordinary purposes, however, the process devised by H. Debray (*Compt. rend.*, 1883, **96**, 928), slightly modified as follows, seems to give rapid and satisfactory results. The dried oxalates were boiled with strong nitric acid until completely decomposed, the solution was evaporated to dryness, the last part of the process being conducted on a sand-bath, and the anhydrous nitrates mixed with twice their weight of sodium nitrate were fused in a porcelain dish until no more nitrous fumes were evolved. The cold mass was detached from the dish, coarsely powdered, and digested in warm water acidified with nitric acid. The insoluble, pale yellow ceric oxide was collected and washed with ammonium nitrate solution, as recommended by Schützenberger (*Compt. rend.*, 1895, **120**, 663). If pure water is used, the finely-divided ceric oxide will pass through the filter. The filtrate was again evaporated to dryness and fused so as to eliminate the remainder of the cerium. The lanthanum and "didymium" were subsequently separated by fractional crystallisation of the oxalates from strong nitric acid solution, as will be described in a future communication.

(6) Very pure ceria can be obtained by the following method, which depends on the use of chromic acid. The solution of nitrates was precipitated with caustic soda, and the hydroxides were washed several times by decantation with boiling water. A warm aqueous solution of chromic acid was then added and the whole left for several days. A heavy, yellowish-white precipitate remained, which, on ignition at a gentle heat, yielded cerium sesquioxide as an almost white powder

without the slightest tinge of red or yellow. When thus obtained, the oxide dissolved readily in boiling hydrochloric acid, and the solution, even when viewed through a considerable thickness, did not show a trace of absorption bands.

This last method will be further studied. A chromic-acid method was formerly devised by Pattinson and Clarke (*Chem. News*, 1867, **16**, 259), but the process is entirely different from the foregoing, and has the disadvantage of giving a ceric oxide which is absolutely insoluble in acids.

15. "A synthesis of aldehydes by Grignard's reaction."

By Gordon Wickham Monier-Williams.

Gattermann and Maffezzoli (*Ber.*, 1903, **36**, 4152) showed that aldehydes could be obtained by the action of organo-magnesium compounds on ethyl formate:— $H\cdot CO\cdot O\cdot C_2H_5 + IMgX = C_2H_5\cdot O\cdot MgI + X\cdot CHO$, and various other investigators have carried out analogous syntheses with derivatives of ethyl formate, for example, bromoform, iodoform, ethyl orthoformate, disubstituted formamides, and *iso*nitriles. The author has shown that ethoxymethyleneaniline,

$$C_6H_5\cdot N\colon CH\cdot O\cdot C_2H_5,$$

reacts readily with organo-magnesium compounds to give the anhydro-compound of aniline with the aldehyde in question, from which the latter is easily obtained. The yields are in many cases far better than those given by the older methods. Ethoxymethyleneaniline was prepared by the action of ethyl iodide on the silver derivative of formanilide, $C_6H_5N\colon CH\cdot OAg$ (Comstock and Kleeberg, *Amer. Chem. J.*, 1890, **12**, 497), and was allowed to react in absolute ethereal solution at 35° on organo-magnesium compounds. Benzaldehyde, *o*-tolualdehyde, α- and β-naphthaldehydes were obtained from the respective bromo-compounds with yields of 46, 54, 48, and 36 per cent. respectively. Some derivatives of β-naphthaldehyde were prepared and analysed, notably β-naphthylacrylic acid,

$$C_{10}H_7\cdot CH\colon CH\cdot CO_2H,$$

and dinitro-β-naphthaldehyde, $C_{10}H_5(NO_2)_2\cdot CHO$. The method was then applied to the synthesis of a new aldehyde, *p*-thiophenetylaldehyde, $C_2H_5S\cdot C_6H_4\cdot CHO$. *p*-Nitrothiophenetole (Blanksma, *Rec. trav. chim.*, 1901, **20**, 403) on reduction gave *p*-thiophenetidine,

$$C_2H_5S\cdot C_6H_4\cdot NH_2,$$

a slightly yellow liquid boiling at 280°. Its acetyl derivative is thiophenacetine, which, however, does not exert the physiological action of phenacetine. The base was successively converted into the iodo-compound, $C_2H_5S\cdot C_6H_4I$, a slightly yellow oil boiling at 146°/11 mm., and the aldehyde, $C_2H_5\cdot S\cdot C_6H_4\cdot CHO$, boiling at 245°. Several derivatives of the latter were prepared, of which the azine is very characteristic. The oxidation of the aldehyde with alkaline permanganate gave rise to a sulphonecarboxylic acid, $C_2H_5 \cdot SO_2 \cdot C_6H_4 \cdot CO_2H$.

16. "The action of ultra-violet light on moist and dry carbon dioxide." By Samuel Chadwick, John Edwin Ramsbottom, and David Leonard Chapman.

By the action of ultra-violet light on dry carbon dioxide, the authors have succeeded in partially decomposing carbon dioxide into carbon monoxide and oxygen. The circumstances of the experiment rendered it impossible to decide what percentage of the oxygen was present in the form of ozone. If the carbon dioxide is moist there is no decomposition. The peculiar influence of water vapour is believed to be due to the action which it exerts on the vibrations of the electrons of the atoms of which the molecules of carbon monoxide, carbon dioxide, and oxygen are composed. The facts, discovered by Chapman and Burgess, concerning the induction period of a mixture of chlorine and hydrogen are regarded as confirming this view.

17. "A contribution to the study of stable diazo-compounds. Preliminary note." By Gilbert Thomas Morgan and William Ord Wootton.

p-Aminobenzanilide, which has been shown to give on diazotisation a stable diazo-carbonate and a corresponding nitrite (*Trans.*, 1905, **87**, 938), also furnishes a diazonium picrate,

$$C_6H_5 \cdot CO \cdot NH \cdot C_6H_4 \cdot N_2 \cdot O \cdot C_6H_2(NO_2)_3,$$

which is precipitated even in the presence of hydrochloric acid. This substance, which is insoluble in water and crystallises from warm alcohol in rosettes of yellow needles decomposing at 132°, does not explode on percussion. When dissolved in aqueous caustic soda and added to alkaline β-naphthol, it yields a precipitate of benzoyl-*p*-aminobenzeneazo-β-naphthol. Mercury acetamide has been found to yield sparingly soluble, stable additive compounds when added to the aqueous solution of a diazonium salt, and a series of these substances is under investigation. The compound with benzenediazonium chloride gave, on analysis, $N = 12{\cdot}46$, whereas $C_6H_5 \cdot N_2Cl, Hg(NH \cdot CO \cdot CH_3)_2$ requires $N = 12{\cdot}26$ per cent. Similar stable mercury acetamide derivatives have been obtained from the substituted anilines and their homologues.

18. "Triarylsulphonium bases." By Samuel Smiles and Robert Le Rossignol.

Quite recently Kehrmann and Duttenhöfer have published a paper (*Ber.*, 1905, **38**, 4197) dealing with mono- and di-arylsulphonium bases, and, although their work does not clash with that of these investigators, the authors considered it desirable to communicate the following preliminary note to the Society.

It has been found that triarylsulphonium bases can be prepared in three ways.

(1) By the action of thionyl chloride on a phenol or phenolic ether in presence of aluminium chloride.

(2) By the action of a sulphinic acid on a phenolic ether in presence of concentrated sulphuric acid.

(3) By the condensation of an aromatic sulphoxide with phenols or their ethers.

It can be shown that sulphoxides are formed during the first and second reactions, and hence the third reaction may be regarded as the final stage of the first two. The condensation between sulphoxide and phenol takes place with acid condensing agents, and it is the authors' view that the sulphoxide, being basic in character, first forms a salt $Ar_2S(SO_4H)\cdot OH$, which then reacts with the phenol, losing hydroxyl and forming the sulphonium salt, thus:

$$Ar_2S(SO_4H)\cdot OH + C_6H_5\cdot OH = Ar_2S\cdot C_6H_4(OH)\cdot SO_4H + H_2O.$$

This reaction seems to be reversible and a slight excess of phenol must be present to render the conversion of sulphoxide to sulphonium salt complete. At present only the hydroxy- and ethoxy-derivatives have been examined, but the authors hope to extend the investigation to amide and other compounds.

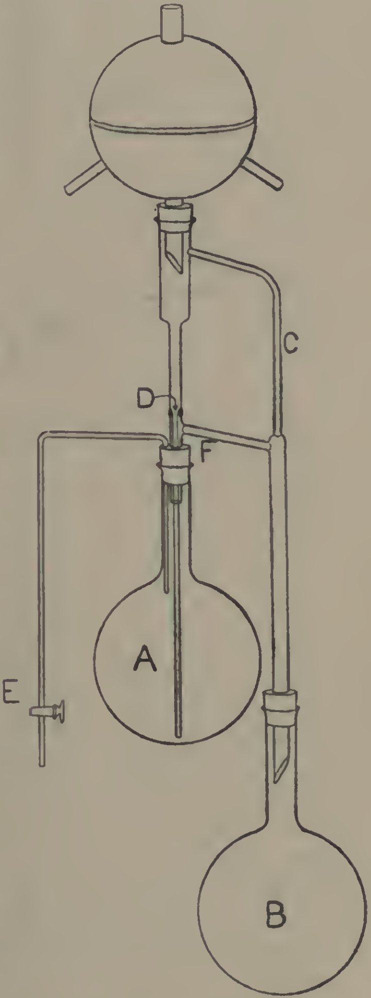
19. "An improved apparatus for the continuous extraction of liquids with ether." By Richard Sisson Bowman.

The apparatus here described differs essentially from those due to Hagemann (*Ber.*, 1893, **26**, 1975), Pellizza (*Chem. Centr.*, 1904, **1**, 851), and Mameli (*loc. cit.*, 1905, **2**, 106). In the latter, hot ether vapour is blown through the liquid to be extracted, whilst in the former the extraction is effected by passing cool liquid ether through the solution. Violent bubbling is thus avoided, together with the consequent risk of carrying over mechanically into the ether flask some of the liquid to be extracted.

The apparatus comprises a simple system of tubes, a condenser, and two ordinary flasks, preferably round bottomed.

The liquid to be extracted is placed in the flask *A* in sufficient quantity to very nearly fill the flask to the bottom of the neck. This flask may frequently be replaced with advantage by a wide test-tube. From one-eighth to one-fifth of this volume of ether, with which the substance is to be extracted, is placed in the flask *B*, which is heated on a water-bath or electric heater. The ether passing as vapour up tube *C* is condensed in the condenser and falls back and collects in the inner tube, *D*. A column presently accumulates in *D* long enough to force its way through the liquid in *A*, and there is then a constant succession of small drops of ether ascending in *A*, collecting on the surface of the liquid, and finally overflowing at *F* and returning to the flask *B*.

On completion of the process of extraction, the neck of the flask will be filled with ether. There will also be a column of ether in tube *D*, reaching a few centimetres above tube *F*, and hence the neck of the flask may be emptied by opening the stopcock *E* and allowing the ether to run off into some vessel. If necessary, the flask may now be replaced by a similar one containing a fresh portion of the liquid to be extracted and the process resumed.



Among other advantages claimed for this apparatus are that whereas the other forms involve either expert glass blowing or innumerable cork and india-rubber joints, it is simple in construction and may easily be made by anyone moderately skilled in the use of the blowpipe. It is very easy to keep clean and convenient to charge, since the vessels which contain the liquid to be extracted and the extracting liquid are ordinary flasks. A large quantity of liquid, moreover, may be rapidly and completely extracted with the use of a very small quantity of ether.

Benzene, ligroin, or any other suitable solvent may be used with equal ease, provided it is immiscible with water and of lower specific gravity than the liquid which it is to be used to extract.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Aschan, *Ossian.* Chemie der alicyklischen Verbindungen. pp. xlv + 1163. Braunschweig 1905. (*Recd.* 7/12/05.)
From the Publishers.

Carnegie, *Douglas.* Law and theory in chemistry. pp. 222. London 1894. (*Recd.* 21/12/05.) From Professor R. Meldola.

Richmond, *H. Droop.* The laboratory book of dairy analysis. pp. viii + 90. ill. London 1905. (*Recd.* 20/11/05.)
From the Author.

Thresh, *John C.* The examination of waters and water supplies. pp. xvi + 460. ill. London 1904. (*Recd.* 18/12/05.) From the Author.

Walker, *A. Jamieson,* and **Mott,** *Owen E.* An introduction to volumetric analysis. pp. x + 64. London 1905. (*Recd.* 20/12/05.)
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II. *By Purchase.*

Abney, *Sir William de Wiveleslie.* Instruction in photography. 11th edition. pp. 676. ill. London 1905. (*Recd.* 18/12/05.)

Borel, *Pierre.* Bibliotheca chimica seu catalogus librorum philosophicorum hermeticorum in quo quatuor millia circiter, authorum chimicorum, vel de transmutatione metallorum, re minerali, et arcanis, tam manuscriptorum, quam in lucem editorum, cum eorum editionibus, usque ad annum 1653 continentur. pp. xii + 276. Paris 1654. (*Recd.* 19/12/05.)

Boyle, *Hon. Robert.* New experiments and observations touching cold, or an experimental history of cold, begun. To which are added an examen of antiperistasis, and an examen of Mr. Hobs's doctrine about cold. Whereunto is annexed an account of freezing, brought in to the Royal Society, by the learned Dr. C. Merret, a Fellow of it. pp. lviii + 845 + 54. ill. London 1665. (*Recd.* 18/11/05.)

Chemisch-technische Untersuchungsmethoden. Edited by *Georg* Lunge. Vol. III. pp. xxvii + 1305 + xliv. ill. Berlin 1905. (*Recd.* 18/12/05.)

Church, *Arthur Herbert.* Precious stones considered in their scientific and artistic relations. pp. x + 135. ill. London 1905. (*Recd.* 28/12/05.)

Doelter, *C.* Physikalisch-chemische Mineralogie. pp. xi + 272. ill. Leipzig 1905. (*Recd.* 21/12/05.)

Eder, *Josef Maria.* Geschichte der Photographie. pp. xvi + 484. ill. Halle a. S. 1905. (*Recd.* 18/12/05.)

Heddle, *M. Forster.* The mineralogy of Scotland. Edited by *J. G.* **Goodchild.** 2 vols. pp. lviii + 148, viii + 247. ill. Edinburgh 1901. (*Recd.* 20/12/05.)

Kayser, *Edmond.* Microbiologie agricole. pp. xii + 440. ill. Paris [1905]. (*Recd.* 20/12/05.)

At the next Ordinary Meeting, on **Thursday,** February **1st,** 1906, at **8.30** p.m., the following papers will be communicated :

"Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates)." By Tamemasa Haga.

"Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives." By M. O. Forster.

"The relation between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group." By A. W. Stewart and E. C. C. Baly.

"The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones." By E. C. C. Baly and A. W. Stewart.

"The relation between absorption spectra and chemical constitution. Part III. The nitranilines and the nitrophenols." By E. C. C. Baly and A. W. Stewart.

"The action of light on benzylidenephenylhydrazine." By F. D. Chattaway.

"The union of chlorine and hydrogen." By D. L. Chapman and C. H. Burgess.

"Note on the molecular weight of adrenaline." By G. Barger and A. J. Ewins.

"The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds." By J. Campbell Brown.

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Issued 9/2/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 304.

Thursday, February 1st, 1906, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Mr. J. B. Tillott was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Roderick Harold Capper Birt, B.A., 54, Shooter's Hill Road, Blackheath, S.E.
William Dickson, Branksome, Bridge of Weir.
James Stuart Hills, 225, Oxford Street, W.
Ernest Ormerod, M.Sc., Ph.D., 8, Leopold Road, Wimbledon, S.W.
John Henry West, 11, Sydney Street, Chelsea, S.W.
Henry John Wiffon, 17, Albany Road, Manor Park, E.

Of the following papers, those marked * were read :

*20. "Hydroxylamine-$\alpha\beta$-disulphonates (structural isomerides of hydroximinosulphates or hydroxylamine-$\beta\beta$-disulphonates)." By Tamemasa Haga.

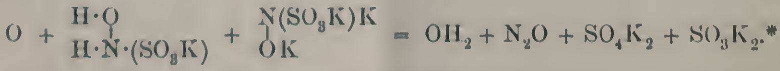
In a previous paper (*Trans.*, 1904, **85**, 78 ; Proc., 1903, **19**, 281), it was shown that Fremy's *metasulphazilates* are *hydroxylaminetrisulphonates.* From these salts there has now been obtained by hydrolysis a new series of salts which are structurally isomeric with Fremy's *neutral* and *basic sulphazotates*, now known to be *hydroxylaminedisulphonates.* The new salts are decomposed by sodium amalgam, and are proved by the nature of this change, by their decomposition by concentrated potassium hydroxide solution, and by their hydrolysis, to be *hydroxylamine-aβ-disulphonates*, in contrast with the *sulphazotates*, which are *hydroxylamine-ββ-disulphonates*, $SO_3K\cdot ONH\cdot SO_3K$ and $HON(SO_3K)_2$, respectively. This is believed to be the first indisputable case of the occurrence of fundamental structural isomerism among inorganic compounds. Sodium converts the new salts into sulphate and aminemonosulphonate; potassium hydroxide into the same products, together with nitrogen; and acids transform them into sulphate and hydroxylamine. The new salts are practically all soluble in water and fairly stable; those prepared are principally the di- and tri-potassium salts, di- and tri-sodium salts, and the di-ammonium salt. A *hydroxylamine-α-monosulphonate* seems incapable of existence; it would be, for example, a sulphate of potassium and amidogenium, $H_2NO\cdot SO_2\cdot OK$.

Discussion.

Dr. Divers said that it follows somewhat unexpectedly from the author's results that it is the presence of oxylic hydrogen and not aminic hydrogen in a hydroxylamine derivative or in hydroxylamine itself which makes it easily oxidisable. For, whilst a hydroxylamine-αβ-disulphonate is not sensitive to oxidising agents, although it contains an atom of aminic hydrogen, a hydroxylamine-ββ-disulphonate which contains none is readily oxidised to a peroxylaminesulphonate (*Trans.*, 1904, **85**, 78; Proc., 1903, **19**, 281) by virtue of the oxylic hydrogen atom, which is present in it but not in the αβ-salt. Applying this deduction from facts to the case of the very sensitive hydroxylaminemonosulphonates, an explanation is found for the fact that these salts, when oxidised, as by cupric chloride or by cupric oxide in alkaline solution (*Trans.*, 1889, **55**, 760), give nitrous oxide but no hyponitrite, although when decomposed by potassium hydroxide alone they give much hyponitrite, together with sulphite. The production of hyponitrite by alkali alone is represented by

$$2(SO_3K)HNOH + 4KHO = 2(SO_3K)KNOK + 4H_2O = 2SO_3K_2 + (NOK)_2 + 4H_2O.$$

Its non-production, when cupric oxide is also present, is accounted for by the equation:



$$O + \begin{matrix} H\cdot O \\ | \\ H\cdot N\cdot (SO_3K) \end{matrix} + \begin{matrix} N(SO_3K)K \\ | \\ OK \end{matrix} = OH_2 + N_2O + SO_4K_2 + SO_3K_2.\text{[*]}$$

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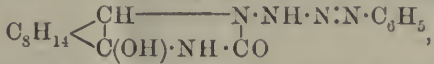
[*] Copper sulphate induces oxidation of a hydroxylaminemonosulphonate catalytically, causing one-half of it to be reduced to aminemonosulphonate in oxidising the other half in the way just formulated (compare *Trans.*, 1900, **77**, 978).

It should therefore be taken into consideration, when determining the constitution of organic and other substitution derivatives of hydroxylamine, that indifference to oxidising agents is not evidence of the absence of aminic but of oxylic hydrogen.

He also suggested, in explanation of the fact that a small part of a hydroxylamine-*αβ*-disulphonate is much more difficult to hydrolyse than the rest, that the salt may polymerise to some extent during the heating and thus become resistant to hydrolysis.

In reference to the circumstance that some of the author's results had been anticipated by Raschig (*Ber.*, 1906, **39**, 245), and the question of dating communications having been raised by Professor McLeod, Professor Armstrong expressed the hope that no alteration in the existing practice would be made, and that nothing would be done to deprive authors of the liberty which they had so long enjoyed of correcting their papers up to the moment of publication. It was most undesirable that anything should be done to encourage discussions as to priority among authors. The public were gainers when, as in the present case, independent workers arrived at similar results.

*21. "Studies in the camphane series. Part XXI. Benzenediazo-ψ-semicarbazinocamphor and its derivatives." By Martin Onslow Forster.

When a diazonium salt is added to an aqueous solution of camphoryl-ψ-semicarbazide nitrate, the corresponding derivative of *benzenediazo-ψ-semicarbazinocamphor*,  $C_8H_{14}<\begin{matrix} CH\text{———}N\cdot NH\cdot N\colon N\cdot C_6H_5 \\ C(OH)\cdot NH\cdot CO \end{matrix}$, is precipitated. Compounds of this class may be called diazo-ψ-semicarbazines, and have been obtained from diazotised aniline, *p*-toluidine, *p*-anisidine, *p*-chloroaniline, *p*-bromoaniline, and the three nitroanilines; they are characterised by the readiness with which dilute alkalis resolve them into camphoryl-ψ-carbamide and the corresponding phenylazoimide. The author dissented from the views on coloured camphor derivatives expressed by Armstrong and Robertson (*Trans.*, 1905, **87**, 1272).

Discussion.

In replying to Dr. Forster, Prof. Armstrong said that, beyond remarking that Stobbe's results were in no way irreconcilable with his (the speaker's) views as to the origin of colour, as he proposed to consider them on another occasion, he should not deal with them then; nor would he continue the discussion on the relation of optical activity to structure in hydrazones, as this subject could not be dealt with properly in the time at disposal. He would confine his remarks to the compounds described by Dr. Forster. Of the two alternative formulæ available for the semicarbazines, Dr. Forster had selected that containing the group $\cdot\underset{\cdot}{\mathrm{N}}\cdot\mathrm{NH}\cdot\mathrm{N}\colon\mathrm{NPh}$. Inasmuch as compounds containing the group $\cdot\mathrm{N}\colon\mathrm{NPh}$ were at least *yellow*, he was of opinion that the formula selected did not represent the *colourless* compounds. He was of opinion also that, although prepared by one method, Dr. Forster's compounds were not all of one type, any more than *o*- and *p*-nitrophenol and nitraniline were compounds of the same type as the corresponding bromophenols and bromanilines. It had long been admitted that the nitro-compounds referred to are at least partially composed of the isodynamic quinonoid forms; the differences observed by Dr. Forster between his colourless and coloured compounds were precisely those observed on comparing the bromanilines with the nitranilines.

Dr. LANDER remarked that it was unlikely that nitrogen compounds of this type would exhibit tautomerism. Pechmann had shown that the so-called "virtually tautomeric" mixed amidines were mixtures or "solid solutions" of structural isomerides, and further that the isomerism disappeared when the hydrocarbon residues were of different types, as in Dr. Forster's compounds.

Dr. LOWRY said that Dr. Forster appeared to have overlooked the fact that one of Stobbe's compounds, the phenyldimethylfulgide (*Ber.*, 1905, **38**, 3895) existed both in a yellow and in a colourless form, the two forms being convertible into one another in much the same way as the isomeric white and yellow oximes of the mesoxamide series studied by Dr. Whiteley (*Trans.*, 1903, **83**, 24). There was, therefore, the clearest possible evidence of the existence of dynamic isomerism in Stobbe's series of compounds, and the argument that individual members of such a series must have the same constitution because prepared in the same way and exhibiting similar chemical properties was entirely fallacious.

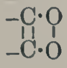
Dr. MORGAN cited the case of the ortho-diazoimines as another example of a group of compounds the members of which series differed considerably in colour although they were all prepared by the same general method and had similar properties. Diazoiminobenzene and its acyl derivatives were white or colourless substances. 2 : 3-Diazoiminonaphthalene was described as yellow, whereas 1 : 8-diazoiminonaphthalene is brownish-red. In spite of this colour difference there seemed to be no reason for supposing that these substances were differently constituted.

Although three of Dr. Forster's diazo-ψ-semicarbazines were nitro-compounds and possibly owed their colour to the presence of the nitro-group, yet it was very unlikely that the yellow *p*-anisyl derivative should be differently constituted to the white p-tolyl compound, inasmuch as the former differed from the latter only in the substitution of methoxyl for methyl in the para-position to the diazo-complex.

Dr. FORSTER, in reply, regretted that Dr. Lowry had misunderstood his attitude. He had not used "the argument that individual members of such a series must have the same constitution because prepared in the same way and exhibiting similar chemical properties." His contention was, that in the absence of chemical distinctions among a series of compounds prepared alike, it was unsafe to say that the structural type of a colourless compound must differ from that of a coloured one merely because the substances differed in appearance. That was his reason for criticising the views of Professor Armstrong and Mr. Robertson regarding the structure of their camphorquinonehydrazones, and nothing had been said that evening which impaired his conviction that to deduce a certain constitutional formula for a coloured substance solely from the assumption that the colour is due to the constitution ascribed is arguing in a circle, and therefore unacceptable.

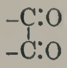
*22. "The relations between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group." By Alfred Walter Stewart and Edward Charles Cyril Baly.

Attention has been drawn (*Trans.*, 1904, **85**, 1029, and 1905, **87**, 766) to the relation which exists between tautomerism and the selective absorption which is shown by the spectra of derivatives of ethyl acetoacetate, whilst it has also been proved that the rates of addition of sodium hydrogen sulphite to ketones can be influenced by the introduction of a carboxyl radicle into the molecule, and that the effect thus produced is directly opposite to what one would expect if the hypothesis of steric hindrance held good (*Trans.*, 1905, **87**, 185, and *Proc.*, 1905, **21**, 78). In the present paper, it is shown that these two phenomena are connected with one another, and the relation is indicated between the activity of the carbonyl group in certain ketones and their selective absorption. It is pointed out that in certain cases the phenomena of tautomerism furnish an explanation of the exceptional reactivity of the carbonyl group, as the passage from the enolic to the ketonic form would give rise to a carbonyl radicle, the condition of which may be considered as approximating to that of a nascent atom. This "nascent carbonyl group" would be more reactive than the normal carbonyl. But although in most instances tautomerism suffices to explain the phenomena, it breaks down in several cases, and to cover these a new and wider conception is required. From spectroscopic evidence it appears that in the α-diketones a vibration is going on which to a certain extent resembles that which was found in the case of ethyl acetoacetate and its derivatives. The nature of this vibration cannot be easily expressed in the ordinary structural formulæ without the possibility of misconception, but it may be indicated somewhat as follows. The vibration is brought about by some change in the relations between the carbon and oxygen atoms, and it in some respects resembles the transition from the ketonic to the enolic form and back again. Using this analogy, we may postulate that the two extreme phases of the vibration can be represented by the formulæ:



$$\begin{array}{l} -C\cdot O \\ \;\;\| \quad | \\ -C\cdot O \end{array}$$

I.



$$\begin{array}{l} -C{:}O \\ \;\;| \\ -C{:}O \end{array}$$

II.

The conversion of I into II would give rise to the "nascent carbonyl group," just as the change of the enolic into the ketonic form does. Further, the experimental evidence available shows that some such relation does actually exist between the carbonyl groups of benzoquinone, and the great reactivity of the quinones can be thus explained. It is proposed to term the general phenomenon "*isorropesis*" and to call "*isorropic*" those radicles the activity of which is thus produced.

*23. "The relation between absorption spectra and chemical constitution. Part II. The quinones and α-diketones." By Edward Charles Cyril Baly and Alfred Walter Stewart.

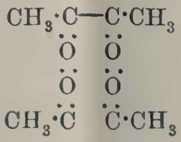
In the preceding communication, it was shown that in the absorption spectrum of ethyl pyruvate an absorption band is developed in a different region and at a different dilution from the bands given by the substances having a labile hydrogen atom (Baly and Desch, Trans., 1904, **85**, 1029; 1905, **87**, 766). This band was shown to be due to the two carbonyl groups in juxtaposition to one another; when two such carbonyl groups are present in the molecule, a new type of oscillation is induced, resulting in the absorption of light of a much longer wave-length than is absorbed by the process of enol-keto-tautomerism. For this new type of oscillation, the name isorropesis was proposed. In the present paper it was shown that this isorropesis in α-diketones results in the absorption of light in the visible blue region, so that the substances are intensely yellow. This is evidenced by camphorquinone and diacetyl. An analogous condition in the close proximity of the carbonyl groups occurs in benzoquinone. It is shown that quinone develops the same absorption band as do diacetyl and camphorquinone. The process of isorropesis occurs therefore in benzoquinone exactly as in the case of the α-diketones and is the origin of the yellow colour of this substance. The same is found to be true in the case of *p*-xyloquinone, toluquinone, α-naphthaquinone, acenaphthenequinone, and phenanthraquinone. There is little doubt, therefore, that the yellow colour of the quinones is due to the isorropesis between the carbonyl groups in juxtaposition. These observations strongly support Armstrong's theory that the colour of certain benzene derivatives is due to the quinonoid linking, for they show that the colour is caused, not directly by this linking, but by the isorropesis between the unsaturated atoms where this linking exists.

*24. "The relation between absorption spectra and chemical constitution. Part III. The nitranilines and the nitrophenols." By Edward Charles Cyril Baly, Walter Henry Edwards, and Alfred Walter Stewart.

In this paper are described the absorption spectra of compounds having the quinonoid linking and containing a nitrogen atom in place of one or both of the quinone oxygen atoms. By a comparison of the absorption spectra of the nitranilines with those of their hydrochlorides, it is shown that the free substances must exist in the quinonoid form, and that, as they show the same absorption band as benzoquinone and the α-diketones, a similar process of isorropesis takes place between the unsaturated nitrogen atoms as between the oxygen atoms of benzoquinone and the α-diketones. Similar arguments are found to hold good for the nitrophenols and for nitrosophenol. By these observations the principle developed in the preceding papers that the colour of the quinones is due to the oscillation or isorropesis between the oxygen atoms is extended to those quinonoid compounds containing nitrogen atoms in the place of one or both of the oxygen atoms.

DISCUSSION.

Prof. ARMSTRONG said that Mr. Baly had put aside entirely the view which had long been held that ketonic interactions were conditioned by the combination of various substances with the carbonyl group and had adopted an entirely *intra*-molecular view of change, whether chemical or physical. He, however, was inclined to advocate the view that the changes were *inter*-molecular. He also still adhered to the opinion that three absorbing centres were required to produce visible colour, *i.e.*, that iodoform, not methylene iodide, might be taken as typical of coloured substances. From this point of view, the colour of compounds such as diacetyl might be accounted for on the assumption that polymeric molecules were present, formed by the association, through the residual affinity of the oxygen atoms, of the ketonic groups, *e.g.* :



$$\begin{array}{c}CH_3\cdot C - C\cdot CH_3\\ \vdots\quad\ \vdots\\ O\quad O\\ \vdots\quad\ \vdots\\ O\quad O\\ \vdots\quad\ \vdots\\ CH_3\cdot C\quad C\cdot CH_3\end{array}$$

This explanation might perhaps apply also to metanitrophenol and metanitraniline. He remarked subsequently that the blue colour of water might be accounted for from this point of view but not by Mr. Baly's hypothesis.

In reply to Prof. Armstrong, Mr. Baly pointed out that the absorption spectrum of acetone and ethyl acetoacetate in aqueous solution shows that the tautomeric process is much decreased by the action of the solvent. Similarly, in the case of benzoquinone, the absorption band due to isorropesis exhibited in alcoholic solution entirely disappears when the substance is examined in aqueous solution, its place being taken by two bands in the ultra-violet region. These facts, due no doubt to the formation of hydrates, are strong evidence against the suggestion made by Prof. Armstrong that the colour of diacetyl is due to a complex of two molecules of this substance.

*25. "The action of light on benzaldehydephenylhydrazone."
By Frederick Daniel Chattaway.

Fischer, who first prepared the ordinary stable α-modification of benzaldehydephenylhydrazone (*Annalen*, 1878, **190**, 135), noted that it reddened when exposed to the air, and this observation was confirmed by Biltz (*Zeit. physikal. Chem.*, 1899, **30**, 527), and Reutt and Pawlewski (*Bull. Acad. Sci. Cracow*, 1903, 503), who added that the reddening takes place on exposure to light, and disappears when the compound is heated or placed in the dark. The author has extended these observations, and shows that the presence or absence of air does not affect the coloration which is brought about by the violet and blue portions of the spectrum only. The changes of colour are probably due to a reversible isomeric change from the hydrazino- to the azo-configuration,

$$C_6H_5\cdot CH{:}N\cdot NH\cdot C_6H_5 \rightleftarrows C_6H_5\cdot CH_2\cdot N{:}N\cdot C_6H_5.$$

The colour produced in benzaldehydephenylhydrazone when it has reached its maximum exactly equals in shade and intensity that of azobenzene itself. This explanation of the colour change is supported by the behaviour of benzaldehydediphenylhydrazone and benzaldehydebenzylphenylhydrazone, which are not capable of undergoing this type of change, and which are not altered in colour by light.

This intramolecular rearrangement caused by light and accompanied by colour change leads to the suggestion that the fading of organic colouring matters in sunlight may in some cases at least be due to a similar reversible isomeric change.

Discussion.

Dr. Wade, who asked whether the author had noticed the production of the coloured modification of the hydrazone at the moment of its formation, more especially in benzene solution, stated that he had experienced great difficulty in obtaining a colourless product when the reacting substances were dissolved in this solvent.

Mr. W. Robertson pointed out that according to the Hantzsch-Werner hypothesis two stereoisomerides are possible; in the case, however, of the benzaldehydephenylhydrazones, three isomeric modifications are known and it is highly probable that all three possess different constitutions. The significance of the colour of the substituted benzaldehydephenylhydrazones when taken in conjunction with the red unstable "benzylidenephenylhydrazine" was explained and the opinion expressed that the nitrobenzaldehydephenylhydrazones were, in reality, stable azo-compounds.

26. "The union of chlorine and hydrogen." By Charles Hutchens Burgess and David Leonard Chapman.

The authors have investigated the dependence of the character of the induction period on the conditions. The results obtained increased the difficulty of explaining the phenomenon in question by the theory of an intermediate compound. They also indicated that the effect must be due to some retarding impurity. The impurity was found to be a gaseous compound resulting from the interaction of chlorine and ammonia. An inhibitive compound can also be formed by the action of chlorine on compounds capable of yielding ammonia on oxidation. When such substances are present in the actinometer, the retarding impurity can be gradually formed for considerable periods of time, so that the mixture after it has been previously induced can again become inert when it is allowed to remain in the dark. If the gases and the water contained in the actinometer are carefully purified from all ammoniacal impurity, no induction period can be observed even after the actinometer has stood for weeks in the dark.

Ammonia (chlorine-substituted ammonia) retards the action between chlorine and formaldehyde in the light. Its inhibitive effect is, however, much less in this case.

No difference could be detected in the absorption coefficients of mixtures in equal volumes of air and chlorine and of hydrogen and chlorine. The energy which brings about the combination of hydrogen and chlorine is therefore probably derived from the light absorbed by the chlorine in virtue of its optical properties.

27. "Note on the molecular weight of epinephrine."

By George Barger and Arthur James Ewins.

Abel and Taveau have recently (*J. Biol. Chem.*, 1905, **1**, 1) objected to the formula $C_9H_{13}O_3N = 183$ for epinephrine (adrenaline), the active principle of the adrenal gland. They prefer the formula $2(C_{10}H_{13}O_3N,\frac{1}{2}H_2O) = 408$, and criticise the molecular weight determinations of previous investigators, arguing that the use of acetic acid is "entirely inadmissible," since the substance cannot be recovered unchanged from the solution. Von Fürth (*Monatsh.*, 1903, **24**, 261) has shown that at least part of the substance can be obtained crystalline by ammonia after evaporating the acetic acid in a vacuum, and the authors have confirmed this observation.

That the loss of epinephrine is extremely small in acetic acid solution was shown by Dr. H. H. Dale, who, using a physiological method indicated by Elliott (*J. Physiol.*, 1905, **32**, 447), finds it possible to estimate epinephrine with an accuracy of about 5 per cent. This physiological method also served as a criterion for the purity of the epinephrine employed, the most active specimen obtained by repeated fractional precipitation with sodium carbonate and ammonia being selected.

The microscopic method of molecular weight determination (*Trans.*, 1905, **87**, 1756) was employed, with glacial acetic acid and with benzaldehyde, at a temperature of 90°.

(I) 0·0732 gram in 2·00 grams of acetic acid was intermediate between 0·19 and 0·214 gram-molecule of benzil per 1000 grams of solvent. M = 172—193.

(II) 0·1016 gram in 2·00 grams of acetic acid was intermediate between 0·166 and 0·18 gram-molecule of acetanilide per 1000 grams of solvent. M = 180—194.

(III) 0·0732 gram in 2·00 grams of acetic acid was intermediate between 0·205 and 0·21 gram-molecule of benzil per 1000 grams of solvent. M = 174—179.

(IV) 0·0732 gram in 2·00 grams of benzaldehyde was intermediate between 0·21 and 0·22 gram-molecule of benzil per 1000 grams of solvent. M = 167—174.

The mean of all these values is 179.

The epinephrine solutions in Experiments II and III were heated to 90° for ten minutes (the time during which the capillary tubes were heated), then diluted with water, nearly neutralised, and made up to 1 in 10,000. On comparison with a solution of the same strength, made by dissolving the solid epinephrine in the minimum quantity of hydrochloric acid, Dr. Dale could not trace any loss of physiological activity.

The value obtained by Jowett (*Trans.*, 1904, **85**, 194) in a very dilute glacial acetic acid solution by the freezing-point method was 135, and by Bertrand (*Compt. rend.*, 1904, **139**, 502) was 174·3. It would appear, therefore, that Abel's formula should be abandoned.

28. "The critical temperature and value of $\frac{ML}{\Theta}$ of some carbon compounds." By James Campbell Brown.

The critical temperatures of a number of organic alcohols, acids, esters, and aromatic hydrocarbons are determined. The latent heats of the repurified substances have been redetermined, and the values of the constant $\frac{ML}{\Theta}$* are calculated for a number of these compounds for which this constant could not be given (*Trans.*, 1903, **83**, 987, and *Trans.*, 1905, **87**, 265). Two or three of the boiling points are given more correctly for the purified substances.

The value of $\frac{ML}{\Theta}$ rises very slightly with the increase of CH_2 in the aliphatic alcohols, acids, and esters, but is very constant for the aromatic hydrocarbons.

29. "Slow oxidations in the presence of moisture." By Norman Smith.

Experiments have been carried out to determine whether the oxidation of ammonia at the ordinary temperature in the presence of air and water could be brought about (1) by catalysis, (2) by induced oxidation. The catalysts used were ferric oxide, stannic oxide, manganese dioxide, lead peroxide, and platinum. Stannic oxide and manganese dioxide produced both nitrite and nitrate from the ammonia (0·05 milligram of nitrate for 5 grams of oxide used); ferric oxide and lead peroxide gave only small amounts of nitrite and nitrate (0·01 milligram of nitrate), whilst platinum appeared to be without action. With platinum heated to a temperature just below dull redness, however, a very dilute solution of ammonia or ammonium salts was readily oxidised in presence of air. In the presence of copper or tin undergoing oxidation in air, ammonia was readily oxidised to nitrite and nitrate; zinc in some experiments gave positive, and in others negative, results, whilst ferrous and manganous hydroxides showed only traces of nitrite or nitrate. In the cases where the formation of nitrate was brought about by induced oxidation, the amount of nitrate produced was much greater than with catalysts.

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* ML = molecular heat of vaporisation, Θ = absolute temperature of the boiling point.

The experiments were extended to the case of nitrogen. No evidence of oxidation of nitrogen by catalysts was obtained. In the presence of substances undergoing oxidation, the metals zinc, iron, and magnesium only among a large number of substances investigated gave ammonia, nitrite, or nitrate. These results were shown to be probably due to traces of nitride in the metals.

Water was evaporated in air under various conditions and it was shown that in no case was ammonium nitrite produced (compare Schönbein, *J. pr. Chem.*, 1861, **84**, 215, and others) if the following sources of error were avoided: (*a*) traces of nitrite in the air, (*b*) nitrites produced in the burning of flames, (*c*) presence of ammonium compounds or albuminoid matter in the water, (*d*) traces of nitride in the metals.

No hydrogen peroxide was produced in the evaporation of water under various conditions, except in presence of certain metals such as zinc, which undergo rapid oxidation at the same time.

30. "Fischer's salt and its decomposition by heat."

By Prafulla Chandra Rây.

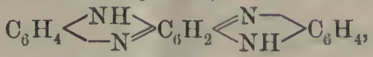
Fischer's salt as ordinarily prepared seems to correspond to the formula $Co_2(NO_2)_6,6KNO_2,3H_2O$. It is, however, invariably contaminated with appreciable traces of an oxide of cobalt. The method of Rosenheim and Koppel evidently does not yield a purer product as claimed by them. The salt when heated in a vacuum decomposes according to the following equation:

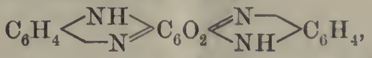
$$Co_2(NO_2)_6,6KNO_2,3H_2O = Co_2O_3 + 6NO + 3KNO_3 + 3KNO_2 + 3H_2O.$$

On this decomposition is based an accurate and expeditious method of analysing the compound.

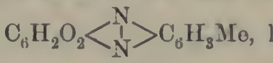
31. "Action of quinones on *o*-diamines, *o*-nitroaniline, *m*-nitroaniline, and 2-nitro-*p*-toluidine. A preliminary note." By James Leicester.

In a previous paper (*Ber.*, 1890, **23**, 2793; Abstr., 1890, 1445), it was shown that the action of *o*-nitroaniline and 2-nitro-*p*-toluidine on benzoquinone, toluquinone, and naphthaquinone was the same in principle as that occurring in the case of aniline and benzoquinone. Quinonefluorindines and quinonephenazine derivatives were obtained on reduction with ammonium sulphide (Proc., 1893, **9**, 9).

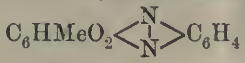
Homofluorindine,  $C_6H_4<^{NH}_{N}>C_6H_2<^{N}_{NH}>C_6H_4$, has been now prepared from quinonehomofluorindine,



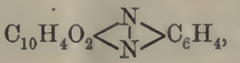
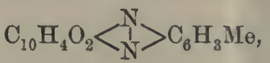
$$C_6H_4<^{NH}_{N}>C_6O_2<^{N}_{NH}>C_6H_4,$$

by reduction with hydriodic acid (O. Fischer and E. Hepp, *Ber.*, 1890, **33**, 2789, and *Ber.*, 1888, **21**, 683). Various salts of the base have been made. Quinone-α-methylphenazine,  $C_6H_2O_2<^{N}_{N}>C_6H_3Me$, has also been reduced in a similar way. Some of the salts dissolve in alcohol with a deep blue colour and have a red fluorescence; the slightest trace of ammonia changes the colour to bright red with a strong fluorescence.

The absorption spectra of some of the compounds are under investigation with a view to the question of the origin of colour in organic compounds. Quinonephenotolazine,

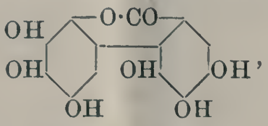


$$C_6HMeO_2<^{N}_{N}>C_6H_4\ [N:N:Me=2:3:5],$$

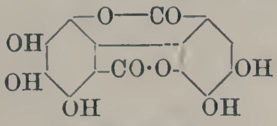
naphthaquinonephenazine,  $C_{10}H_4O_2<^{N}_{N}>C_6H_4$, and α-naphthaquinonetolazine,  $C_{10}H_4O_2<^{N}_{N}>C_6H_3Me$, are also being examined in a similar manner.

32. "Some oxidation products of the hydroxybenzoic acids. II." By Arthur George Perkin.

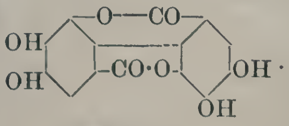
When gallic acid dissolved in 76 per cent. sulphuric acid is oxidised by means of potassium persulphate, a colouring matter very similar to ellagic acid is produced. This substance, $C_{14}H_6O_9$, to which the name *flavellagic acid* is assigned, is obtained in yellow needles (m. p. above 360°) and dissolves in alkalis with a greenish-yellow coloration, and gives an *acetyl* compound, $C_{14}HO_9(C_2H_3O)_5$ (colourless needles, m. p. 317—319°), and a *benzoyl* derivative, $C_{14}HO_9(C_7H_5O)_5$ (prismatic needles, m. p. 287—289°). On distillation with zinc dust, it gives *fluorene*, and on digestion with boiling potassium hydroxide solution is converted into a substance, $C_{13}H_8O_8$ (m. p. above 360°), the alkaline solution of which develops a bluish-violet colour on oxidation. It crystallises with $1H_2O$ in almost colourless needles, gives an *acetyl* compound, $C_{13}H_2O_8(C_2H_3O)_6$ (prismatic needles, m. p. 232—234°), and a corresponding *benzoyl* derivative (m. p. 261—263°). The results indicate that this substance is *hexahydroxydiphenylmethylolid*,



and that flavellagic acid is *hydroxyellagic acid*.



Flavellagic acid.



Ellagic acid.

When gallic acid is oxidised in acetic acid by means of potassium persulphate and sulphuric acid, *ellagic acid* is formed, and this process is preferable to that in which concentrated sulphuric acid is employed as the solvent (*Proc.*, 1905, **21**, 185), owing to the simultaneous production in this case of a small quantity of flavellagic acid. These colouring matters could only be separated in the form of their benzoyl derivatives.

33. "Contributions to the chemistry of oxygen compounds. Part I. The compounds of tertiary phosphine oxides with acids and salts." By Robert Howson Pickard and Joseph Kenyon.

Tertiary phosphine oxides are easily prepared by the action of phosphorus oxychloride on organo-magnesium compounds. They combine with acids, metallic salts, and organo-magnesium iodides, forming compounds having the general formulæ $(R_3PO)_2,H_nX$; $(R_3PO)_2,M''X_2$; and $(R_3PO)_2,CH_3MgI$. The compounds described include some of those in which R is methyl, ethyl, propyl, phenyl, or benzyl, HX is ferrocyanic, chloroauric, cobalticyanic, dichromic, camphoric, iodobismuthic, or iodomercuric acids, and $M''X_2$ is zinc chloride or iodide, cadmium iodide, mercuric or cobalt chlorides. Other compounds of the oxides which do not conform to these general formulæ are those with hydrochloric, trichloroacetic, pyruvic, and chloroplatinic acids and cupric chlorides. The constitution of these compounds is best explained by Werner's theory of oxonium compounds (*Annalen*, 1902, **333**, 296). The oxides are very weak bases. Their aqueous solutions do not affect the birotation of dextrose, and their compounds with acids are hydrolysed to a large extent by water.

34. "The rapid electro-analysis of metals. Preliminary note." By Henry Julius Salomon Sand.

A method for the rapid electro-deposition of metals for analysis and their separation by graded potential has been elaborated. Silver has thus been accurately separated from copper in about six minutes from boiling acetate solutions, more than half a gram being deposited without the use of an auxiliary electrode. Copper was separated from bismuth from a boiling tartrate solution (time: about eight minutes). An auxiliary electrode is necessary. The operation must be repeated once, as the first deposit contains traces of bismuth. Owing to the high stirring-efficiency of the electrodes, bismuth has been easily obtained in a perfectly adherent form from nitrate solutions, the time required being about ten minutes, with no auxiliary electrode. By treating the precipitation of bismuth as a separation from hydrogen, perfectly adherent metallic deposits have also been obtained from tartrate and acetate solutions (with the use of an auxiliary electrode). So far the deposition of the following metals has been studied and successfully carried out: copper with currents of ten amperes at about three volts, lead as peroxide, silver from boiling ammoniacal and acetate solutions, and bismuth.

At the next Ordinary Meeting, on **Thursday**, February **15th**, 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Cuprous formate." By A. Angel.

"The solubility of triphenylmethane in organic liquids with which it forms crystalline compounds." By H. Hartley and N. G. Thomas.

"The spontaneous crystallisation of supersaturated solutions." By H. Hartley.

"The preparation and properties of some new tropeines." By H. A. D. Jowett and A. C. O. Hann.

"Studies in asymmetric synthesis. Part IV. The application of Grignard's reaction for asymmetric syntheses." By A. McKenzie.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Thursday, 15th February, 1906.

Banner, George Ernest,

"Brooklyn," Highfield Road, Rock Ferry, Cheshire.

Manager of Chemical Works, Bankhall, for Samuel Banner & Co., Ltd. Have been a student under Messrs. A. Norman Tate & Co. for some time and engaged in chemical work for the last ten years, also during the last 18 months I have been manager of Chemical Works for Messrs. Samuel Banner & Co., Ltd., Liverpool. I wish to join the Society so as to be in closer touch with the subject and obtain the Journal.

Francis Henry Tate. James Smith.
Alfred Smetham. *Wm. P. Thompson.*
Walter S. Spencer.

Barker, Arthur Ernest,

3, York Road, Chorlton-cum-Hardy, Manchester.

Schoolmaster. At present studying at University College, London. B.Sc. (London), B.A. (London). I wish to be able to obtain information as to recent work, and to keep up to date.

William Ramsay. Samuel Smiles.
J. Norman Collie. A. W. Stewart.
W. H. Edwards.

Bell, William Edward,

88, Monk's Road, Lincoln.

Chemist and Manager of Messrs. Tomlinson and Hayward's Chemical Works, Lincoln and Warrington. Studied in the laboratory of Messrs. A. Norman Tate & Co., Liverpool. Engaged in the examination of Coal Tar Oils, Crude Glycerines, Tobaccos, &c. I wish to obtain the latest chemical literature of the day.

Francis Henry Tate. Alfred Shrubsole.
F. Percy Watson. *H. Broadbent.*
W. Birkett.

Blatchley, Charles Frederick Polwhele,

Downside College, Bath.

Science Master at Downside College, near Bath. Second Class Honours, Final Honour School of Natural Science (Chemistry), Oxford, B.A. (Desirous of having the Journal of the Society.)

H. B. Baker. John Watts.
Leonard G. Killby. R. de J. Fleming-Struthers.
Andrea Angel. J. E. Marsh.

Bogue, Thos. Going Stoney,

5, Kenilworth Square, Dublin.

M.P.S.I. I am a Member of the Pharmaceutical Soc. of Ireland, and have studied chemistry in Trinity College under Professors Young and Werner, and also in Mr. Armstedt Ray's laboratories. I am now chemist to Harvey & Co., Ltd., Wholesale Manufacturing Veterinary Chemists.

Sydney Young. Wm. C. Ramsden.
Emil A. Werner. J. Armstedt Ray.
David S. Jardin.

Braid, Arthur Forbes,

Rose Mount, Dumbreck, Glasgow; and 29, Hampton Road, Forest Gate, London, E.

Analytical Chemist. Five years with Messrs. Tatlock & Thomson. City Analysts, Glasgow, 2 years as student and 3 as assistant. Work included analyses of Iron, Tin, Manganese, Copper, and other ores, Iron, Steel, Copper, Brass, and other metals and alloys. Natural and Artificial Manures, &c. Sugars and Molasses, Oils, Fats, and Waxes, Waters and Assaying. Five years Glasgow Technical College training. At present chemist to the Charing Cross, West End, and City Electricity Supply Co., Ltd.

R. R. Tatlock. G. G. Henderson.
R. T. Thomson. Thomas Gray.
A. Humboldt Sexton.

Briggs, Richard Victor,

Sirseah Research Station, Mozufferpore P.O., Bengal.

Assistant, Sirseah Indigo Research Station. Assistant, five years, C. Rawson, Esq., F.I.C., F.C.S., Consulting and Analytical Chemist, Bradford. Connected with the chemistry of indigo in India from 1900–05. Medallist Honours Grade, Wool Dyeing, City and Guilds Institute. Student at Bradford Technical College.

Cyril Bergtheil. Walter M. Gardner.
Robert S. Finlow. *J. Walter Leather.*
D. Hooper.

Caldwell, William,

Mont-Cecil, Bloomfield, Belfast. Demonstrator, Physiological Department, Trinity College, Dublin. M.A., Royal University, Ireland.

Sydney Young. A. Louis Robinson.
Emil A. Werner. W. E. Adeney.
Wm. Cecil Ramsden. Cecil H. Desch.

Clarke, Reginald William Lane,

15, Torridon Road, Hither Green, London, S.E.

Demonstrator and Assistant Lecturer, Goldsmiths' College, New Cross. Studied for three years at the City and Guilds of London Institute, Technical College, Finsbury. Holder of College Certificate in Chemistry. Associate of the Institute of Chemistry. I have conducted research work with Professor Meldola and Dr. Lapworth.

R. Meldola. Arthur Lapworth.
John Castell-Evans. Arthur H. Coote.
F. Henry Streatfeild.

Conyngham, Wm. Boulton,

'Sandon,' Ballsbridge, Co. Dublin.

Pharmaceutical Chemist. Member of the Pharmaceutical Society of Ireland. Past student of the Royal College of Science, Ireland.

W. Palmer Wynne. *Sydney Young.*
W. N. Hartley. *Richard J. Moss.*
Peter MacEwan. *Emil A. Werner.*
James S. Ashe. *Wm. C. Ramsden.*
W. E. Adeney.

Courtauld, Stephen Lewis,

Bocking Place, Braintree.

B.A., Cantab., Natural Science Tripos, 1904. Engaged in research in the Chemical Department of the Central Technical College, South Kensington.

Charles T. Heycock.
Henry E. Armstrong.
Gerald T. Moody.
William A. Davis.
William Robertson.
Edward Horton.

Durrans, Thomas Harold,

1, Cornwall Terrace, Regent's Park, N.W.

Student. Studying Chemistry, Physics, &c., at the Birkbeck College, Chancery Lane, for B.Sc., Lond., with the object of becoming a Manufacturing Chemist. Member of the Faraday Society.

John E. Mackenzie.
H. F. C. Goltz.
Frank E. Weston.
F. Mollwo Perkin.
Alex. McKenzie.

Evans, Frederick Watkins,

3, Charlotte Street, Hull.

Pharmaceutical Chemist. I have been 2 years at the London College of Chemistry, 323, Clapham Road, and having obtained my M.P.S. and Ph.C. desire to pursue further work in Organic Chemistry.

John T. Griffiths.
Thomas Luxton.
Robert J. Porter.
Henry Royal-Dawson.
T. A. Nightscales.
David J. Williams.

Fierz, Hans Eduard, Ph.D.,

Clydach on Tawe, Glamorg., Wales.

Chemist at the Mond Nickel Co., Ltd., Clydach. Three papers published together with M. O. Forster, D.Sc., Ph.D., F.R.S., in the Journal of the Chemical Society.

William A. Tilden.
M. O. Forster.
G. T. Morgan.
Chapman Jones.
James C. Philip.

Glover, Walter Hamis,

38, Ribblesdale Road, Streatham Park, S.W.

Assistant in the Chemical Department, Central Technical College, S. Kensington. Student, 1898—1901, and Junior Demonstrator, 1901—1902, at the Technical College, Finsbury. Studied, 1902—1903, at Würzburg University; and 1903—1905 at Leipzig University under Prof. Hantzsch, and obtained degree of Ph.D. (Leipzig), July, 1905.

Henry E. Armstrong.
T. Martin Lowry.
Gerald T. Moody.
William A. Davis.
William Arthur Lethbridge.
John Vargas Eyre.

Hayworth, William Prince,

119, Clapton Common, London, N.E.

Senior Student in Chemical Department, Technical College, Finsbury, E.C. Certificated Student in Chem. Dept., City and Guilds Tech. Coll., Finsbury, E.C. Senior Student and Junior Demonstrator in Chem. Dept. of above College. Intermediate Associate of Institute of Chemistry Exam. (Pass). Matriculated Student of London University.

R. Meldola. John Castell-Evans.
Lawrence Briant. F. Southerden.
E. W. Bealey.

Irving, Henry Carlyle,

14, Heath Hurst Road, Hampstead, N.W.

Science Student. B.A. (Oxon.) in Chemistry; Marcon Hall [1903]. Engaged in Research Work at the Central Technical College, South Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
Edward Horton.

Jones, Llewellyn Thomas,

Brenig View, Tregaron.

Science Master, County School, Tregaron. Three years' study Chemistry and Physics, University College of Wales, Aberystwyth. B.Sc., University of Wales. Two years Science Master, Tregaron County School.

J. J. Sudborough. F. D. Chattaway.
T. Campbell James. *J. Alan Murray.*
J. P. Millington.

Jones, William Henry Matthews,

Leyden Villa, Chester.

Deputy City Surveyor, Resident Engineer and Analyst in charge of the New Sewage Purification Works, Chester. Being the Analyst in charge of the Sewage Purification Works, and having to make Analyses of the Sewage in its Crude State, and during the various Stages of passing through the different Tanks and Filters before it enters the River Dee, and desiring to profit from the Study of the Publications and lectures of the Society, and to obtain, by visiting other similar works, that information on the subject essential for my purposes which would be more readily obtained if I were a Member of the Chemical Society.

Fredc. H. Bowman. John Welsh.
Edward Halliwell. W. A. Handcock.
W. F. Lowe. *Henry H. Whitehead.*

Le Rossignol, Robert,

2, Cæsarea Place, Jersey.

Research Student. B.Sc. Hons. Chem. "The Velocity Reaction between Potassium Ferricyanide and Potassium Iodide," in conjunction with Prof. Donnan, *Trans. Chem. Soc.*, 1902; "Rate of Decay of Thorium Emanation," in conjunction with C. T. Gimingham, *Phil. Mag.*, 1904.

J. Norman Collie.
J. K. H. Inglis.
N. T. M. Wilsmore.
Samuel Smiles.
Edward C. Cyril Baly.

McDowall, John,

Girdstingwood, Kirkcudbright, Scotland.

Analytical Chemist. One year study Heriot-Watt College (engineering), four years' study Edinburgh University (Chemistry); Foods and Drugs School of Medicine, Edinburgh. Chemist to Backus and Johnston, Co. At present Chemist to Henry J. Monson & Co., Upper Egypt.

Frank Hughes.
Alex. Crum Brown.
Leonard Dobbin.
G. H. Gemmell.
Hugh Marshall.
J. P. Longstaff.

Martin, George Frederick Wesley,

14, Castle Park, Lancaster.

Acting Chemist to Messrs. Maudsley and Son, Chemical Manufacturers, Lancaster, and Organist of Parish Church. I have been a student of science for nine years, and am the inventor of a sheep dip approved by the Board of Agriculture. Former student at the Storey Institute, Lancaster. Have now a private laboratory where I take pupils. Being engaged in research work am anxious to keep in touch with progressive Chemical Science.

Henry Ross.
Rowland Williams.
J. A. Storey.
Percy F. Frankland.
Alex. Findlay.
Alex. McKenzie.

Parfitt, Samuel,

33, Partridge Road, Cardiff.

Deputy and Assistant Manager (Engineering Works, Dry Dock, etc.). Long and careful researches in Siderology and the practical application of improved chemical methods to retard the corrosions in ingot iron and like materials.

F. Gwilym Treharne.
Llewellyn J. Davies.
Thomas Hughes.
J. J. Beringer.
R. W. Atkinson.

Parkin, John,

Blaithwaite, Carlisle.

M.A., Trinity College, Cambridge. Botanist, interested in the chemical side. 1st Class Nat. Sci. Tripos, Pt. I, 1894. 1st Class Nat. Sci. Tripos, Pt. II, 1895 (Botany and Chemistry). Papers:—"Carbohydrates of Monocotyledons," *Phil. Trans., R.S.*, Vol. 191, 1899; "On a Reserve Carbohydrate which produces Mannose from the bulb of Lilium," *Proc. Camb. Phil. Soc.*, Vol. XI, 1901; "India-rubber," *Circular, Roy. Bot. Gardens, Ceylon*, 1899. At present engaged in the study of the carbohydrates of plants.

Horace T. Brown.
W. J. Sell.
J. E. Purvis.
H. O. Jones.
George Dixon.

Perkins, William Hughes,

Harpur Hill, Nr. Buxton.

Demonstrator in Chemistry, The University, Leeds. B.Sc. (1st Class Honours), Manchester University, 1904.

Arthur Smithells.
J. B. Cohen.
W. Lowson.
C. E. Whiteley.
H. M. Dawson.

Pitman, John Edmund,

Hartley Univ. College, Southampton.

Asst. Lecturer and Demonstrator in Chemistry, Hartley Univ. College. Studied chemistry for 3 years (1900—1903) at the Hartley Univ. College, Southampton. Appointed Demonstrator and Asst. Lecturer, 1903, in above College. Hold the B.Sc. degree (Lond.) with Honours in Chemistry. Joint author with Prof. Boyd of "Note on Zeisel Reaction," *J.C.S.*, 1905.

D. R. Boyd.
A. Vernon Harcourt.
J. Brierley.
Geo. Fredk. Phillips.
W. T. L. Leeming.
C. F. Baker.

Rogerson, Harold,

46, Bloomsbury St., Bedford Square, London, W.C.

Research Chemist in the Wellcome Chemical Research Laboratories, London, E.C. B.Sc. (Manchester), 1904. M.Sc. (exam.), 1905. For one year worked with Dr. J. F. Thorpe, Ph.D., at the Victoria University, Manchester, on "Some Alkyl Derivatives of Glutaconic Acid" and also "Some Alkyl Derivatives of Aconitic Acid."

Frederick B. Power.
Harold B. Dixon.
W. H. Perkin, jun.
D. L. Chapman.
Wm. A. Bone.
J. F. Thorpe.
Alfred Holt, jun.

Rowsell, Philip Foale,

Nutbrook, Exmouth.

Analytical and Manufacturing Chemist. Principal of Holman, Ham & Co., Manufacturing Chemists, Exeter. Holder of Certificates in Chemistry under the Kensington Board and Pharmaceutical Society of Great Britain. Author of various articles, on antiquarian matters specially, and others. As a Chemist I desire admission to the Society for the use of Library and current literature as published by them.

William T. Bayne. Albert Cooper.
Harold W. Harrie. *E. J. Jackman.*
Isaac S. Scarf.

Shrimpton, John Kirby,

22, Fountains Terrace, North Rd., Ripon.

Chemist to Messrs. Robt. Kearsely & Co., varnish and colour makers, Ripon. I have studied at the South Western Polytechnic since 1901. I have held the post of Student Demonstrator during the session 1904–5, when I conducted several investigations in conjunction with Professor J. B. Coleman.

S. Skinner. W. E. Oakden.
J. B. Coleman. F. H. Lowe.
J. C. Crocker.

Smith, Frank,

407, Church Rd., Smithills, Bolton.

Science Master. Graduated in Science (Chemistry and Physics) at the Victoria University, Manchester (1903). Teaching chemistry at Bolton Municipal Secondary School. Lecturer in chemistry at Bolton P.T.'s Centre. Wishes to receive Society's publications.

Harold B. Dixon. Norman Smith.
W. H. Perkin, jun. D. L. Chapman.
Wm. A. Bone. G. H. Bailey.

Thornton, Percy Charles,

9, Cantwell Rd., Plumstead, S.E.

Science Demonstrator under the Liverpool Education Committee. I was a Student for little more than 2 years in the Laboratory of University College (1902—1904). Was appointed Student Demonstrator in Chemistry there, relinquishing this post to become Asst. Chemist in Royal Arsenal, Woolwich (1904—1905).

William Ramsay. J. K. H. Inglis.
J. Norman Collie. N. T. M. Wilsmore.
Edward C. Cyril Baly.

Thorp, Arthur William,

210, Sherborne Road, Yeovil.

Analytical Chemist. Assistant in the Laboratory of Mr. Walter Thorp, F.I.C. (Drug Analyst to the Irish Local Government Board), for 7 years; Chemist to Aplin and Barrett, Ltd., for 3 years; is a Member of the Society of Public Analysts.

W. H. Hurtley. H. Droop Richmond.
Walter Thorp. *E. H. Miller.*
Otto Rosenheim.

Tonkin, Ronald William,

37, Oakhill Road, Putney, S.W.

Chief Chemist to the Imperial Tobacco Co., of York Road, St. Luke's. Studied for 3 years at the Central Technical (City and Guilds of London) College, Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
Robert J. Caldwell.

Walker, Franklin Wilfred,

39, Graham Rd., Acton Green, London, W.

Dyers' Chemist. First Class Certificates in Advanced Organic and Inorganic Chemistry; First Class Honours in Wool, Silk, and Cotton Dyeing (City and Guilds of London), with Institute's Silver Medal in each case. Formerly for 3 years Junior Assistant in Dyeing Dept., Yorks. College (now Univ. of Leeds), under late Prof. Hummel. Now Chemist to Messrs. Eastman & Son, Dyers and Cleaners, London. Author of paper on "Bleaching and Stripping Agents," *Journ. Soc. Dyers and Colourists*, Jan. 1905. Wish to keep informed of recent Chemical Research.

A. G. Green. Reginald B. Brown.
A. G. Perkin. M. C. Lamb.
F. E. Robertson.

Warren, Richard Alfred,

"Belle Vue," Hallow Road, Worcester.

A Brewer with Messrs. Hill, Evans & Co., Ltd., Vinegar Works, Worcester. Five years student of Chemistry at the Victoria Institute, Worcester. First Class Advanced and First Class, Stage III, Practical Inorganic Chemistry, South Kensington.

Cecil Cooke Duncan. G. Percy Bailey.
J. Hector Barnes. *Bernard Dyer.*
T. Slater Price.

Watt, Henry Edgar,

19, Summerhill Road, Dartford, Kent.

Chemist, Messrs. Burroughs, Wellcome & Co., Dartford, Kent. Bachelor of Science (Honours in Chemistry, 1900); Master of Science, 1902, Durham University, also Freire-Marreco Prizeman and Medallist and Johnston Chemical Research Scholar (Durham University). Associate of the Institute of Chemistry (Branch "E").

P. Phillips Bedson.
S. Hoare Collins.
F. C. Garrett.
F. H. Lees.
H. A. D. Jowett.

Wechsler, Elkan,

59, Petherton Road, Canonbury, N.

Demonstrator in Chemistry at the Goldsmiths' College, New Cross. I studied at the City and Guilds Technical College, Finsbury, and at the Würzburg University, and have carried out researches under Professors R. Meldola and A. Hantzsch. I graduated at the Würzburg University, taking the Ph.D. degree.

R. Meldola.
Arthur Lapworth.
John Castell-Evans.
L. Eynon.
F. Henry Streatfeild.

Wheaton, Harold Joseph,

21, Chesterton Road, Cambridge.

Chemical Engineer. I have taken the Chemistry course in connection with Engineering at the Central Technical College, and have since held positions as Assistant Analyst in the Thames Conservancy and Kennicott Water Softener Co.'s Laboratories.

Charles E. Groves.
Gerald T. Moody.
Henry E. Armstrong.
William A. Davis.
T. Martin Lowry.

Willett, Herbert William Mills,

The Cedars, Chislehurst. During term: Magdalen College, Oxford.

Student of Chemistry at the University of Oxford.

Henry A. Miers.
D. H. Nagel.
Harold Hartley.
N. V. Sidgwick.
H. B. Baker.

Willstaetter, Richard,

Zürich (V Bergstrasse 25).

Ph.D. Professor of Chemistry, Polytechnicum, Zürich.

George Lunge.
M. O. Forster.
W. H. Perkin, jun.
Rudolf Lessing.
William Ramsay.
James Dewar.
Raphael Meldola.

Wolfe, Ernest Edwin,

Kinsale, Co. Cork, Ireland.

Pharmaceutical Chemist. Member of Pharmaceutical Society, Ireland. Teacher of Practical and Theoretical Chemistry.

J. Armstedt Ray. S. V. O'Connor.
P. J. Fielding. *David S. Jardin.*
Francis Dickinson.

Yates, John William,

71, North Street, Hugglescote, Nr. Leicester.

Science Master, Market Bosworth Grammar School, Nr. Nuneaton. I have been through the course of Chemistry at the Royal College of Science, taking the final for the A.R.C.Sc. in that subject. Have passed the B.Sc. with Honours in Chemistry. As Science Master in the above School, I wish to keep well in touch with recent chemical work and investigations. Oxford Senior, First Class. College of Preceptors, 1st Class Honours (7th). Board of Education Exams.

William A. Tilden. Chapman Jones.
M. O. Forster. James C. Philip.
G. T. Morgan.

The following Certificates have been authorised by the Council for presentation to Ballot under Bye-law I (3):

Grindley, Harry Sands,

Urbana, Illinois.

Professor of General Chemistry, State University of Illinois. B.Sc., University of Illinois, 1888. D.Sc., Harvard University, 1894. Author and joint author of various publications in the German Chemical Society Proceedings, American Chemical Journal; Journal of the American Chemical Society, U.S. Department of Agric. Bulletins, "University Studies" (University of Illinois publications).

Sidney Calvert.

Mace, William,

Hope, Kingston, Jamaica.

Lecturer in Agricultural Science, Board of Agriculture, Jamaica, 1905, now (1906) Chemist, Amity Hall Sugar Factory, Ltd. Desire to be in touch with modern work and Chemical research.

H. H. Cousins.

Talbot, George Stanley,

Ocean Island, c/o P.P. Co., 60a, Pitt Street, Sydney, N.S.W.

Analytical Chemist. Student for three years and four months under the training and instruction of W. A. Dixon, Esq., F.I.C., and Messrs.

Dixon and Byrn, Analysts under the Public Health Act, N.S.W. For the last two years, and at present, Chief Analyst to the Pacific Phosphate Co., Ltd., Sydney, N.S.W. Desire membership to keep in touch with current chemical literature.

George A. Byrn. Will. A. Dixon.
Andrew J. Dixon.

Wastenays, Hardolph,
Brisbane, Queensland.

Analyst, Brisbane Board of Waterworks. Primary Chemical Training, Demonstrator, Chemistry, 2 years, College of Pharmacy, Brisbane. Assistant Government Analyst, Q., under J. Brownlie Henderson, F.I.C., F.C.S. (seven years, February, 1897, to January, 1904). Analyst to Brisbane Board of Waterworks (January, 1904, to date). Paper before Royal Society, Q., August, 1905 ("Description of Enoggera Reservoir, Brisbane, and Methods of rendering it fit for a Town Supply").

J. C. Brünnich. P. W. Jones.
J. Brownlie Henderson. W. A. Hargreaves.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 23/2/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 305.

Thursday, February 15th, 1906, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. H. B. Hartley and H. L. Tidy were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Richard Henry Beckett, B.Sc., Inval, Haslemere, Surrey.
Herbert Reginald Cooper, Redington, Northwood, R.S.O.
Charles Davidson, 37, Herriot Street, Pollokshields, Glasgow.
Edward Gardner, 70, Parliament Hill Mansions, Highgate Road, N.W.
Richard Godfrey Hamilton Garvey, 25, Park Mansions, Battersea.
William Tabor Lattey, Corpus Christi College, Cambridge.
Hamilton McCombie, M.A., B.Sc., Ph.D., The University, Birmingham.
Thomas Jenkins Murray, Ph.D., The University, Birmingham.
Edgar Gall Oliver, M.A., Chigwell School, Essex.
Lawrence George Richardson, 14, Ashgrove, Horton, Bradford.
David Sommerville, B.A., M.D., 31, Manor House, Marylebone.
Foster Sproxton, B.Sc., Uplands, Alexandra Park Road, Wood Green, N.
Harold Augustine Tempany, B.Sc., St. Johns, Antigua, B.W.I.

It was announced that the following changes in the Officers and Council were proposed by the Council.

As Vice-Presidents: Prof. W. H. Perkin, jun., F.R.S., and Dr. Rudolph Messel, *vice* Prof. W. R. Dunstan, F.R.S., and Mr. D. Howard.

As Ordinary Members of Council: Prof. W. Gowland, Dr. H. A. D. Jowett, Dr. F. E. Matthews, and Prof. A. G. Perkin, F.R.S., *vice* Prof. A. E. Dixon, Prof. J. J. Dobbie, F.R.S., Dr. E. J. Mills, F.R.S., and Prof. J. M. Thomson, F.R.S.

Mr. E. Grant Hooper, Dr. H. F. Morley, and Dr. H. R. Le Sueur were elected Auditors to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

George Ernest Banner.
Arthur Ernest Barker, B.A., B.Sc.
William Edward Bell.
Charles Frederick Polwhele Blatchley, B.A.
Thos. Going Stoney Bogue.
Arthur Forbes Braid.
Richard Victor Briggs.
William Caldwell, M.A.
Reginald William Lane Clarke.
Wm. Boulton Conyngham.
Stephen Lewis Courtauld, B.A.
Thomas Harold Durrans.
Frederick Watkins Evans.
Hans Eduard Fierz, Ph.D.
Walter Hamis Glover, Ph.D.
Harry Sands Grindley, D.Sc.
William Prince Hayworth.
Henry Carlyle Irving, B.A.
Llewellyn Thomas Jones, B.Sc.
William Henry Matthews Jones.
Robert Le Rossignol, B.Sc.
John McDowall.
William Mace.
George Frederick Wesley Martin.
Samuel Parfitt.
John Parkin, M.A.
William Hughes Perkins, B.Sc.
John Edmund Pitman, B.Sc.
Harold Rogerson, M.Sc.
Philip Foale Rowsell.
John Kirby Shrimpton.
Frank Smith, B.Sc.
George Stanley Talbot.
Percy Charles Thornton.
Arthur William Thorp.
Ronald William Tonkin.
Franklin Wilfred Walker.
Richard Alfred Warren.
Hardolph Wastenays.
Henry Edgar Watt, M.Sc.
Elkan Wechsler, Ph.D.
Harold Joseph Wheaton.
Herbert William Mills Willett.
Richard Willstaetter, Ph.D.
Ernest Edwin Wolfe.
John William Yates, B.Sc.

Of the following papers, those marked * were read:

*35. "Cuprous formate." By Andrea Angel.

The compound described as cuprous formate by Joannis (*Abstr.*, 1904, i, 644), having the formula $(HCO_2)_2Cu_2,4NH_3,\frac{1}{2}H_2O$, should be named ammonio-cuprous formate, since it is quite different in properties from the substance prepared by dissolving cuprous oxide in an aqueous ammoniacal solution of ammonium formate under petroleum, diluting the solution with alcohol, and acidifying with formic acid, when crystals are deposited which are collected in an atmosphere of hydrogen and washed with ethyl formate. *Cuprous formate*, $(HCO_2)_2Cu_2$, consists of colourless crystals which are very easily decomposed; water immediately hydrolyses the substance to cuprous oxide and formic acid, sodium carbonate solution decomposes it with effervescence, ammonia solution decomposes it with a slight hissing noise, and dilute sulphuric acid at once produces a precipitate of metallic copper. Dilute formic acid acts similarly, although more slowly. Moist air rapidly hydrolyses it, turning it orange-red, but in a desiccator over sulphuric acid it may be preserved apparently for an indefinite time. Owing to the ease with which the substance is decomposed, the preparation requires special precautions in regard to the strength of the solutions employed. The method of preparation may be employed, with modifications, for the production of other cuprous salts.

DISCUSSION.

Mr. A. VERNON HARCOURT said that Mr. Angel's research arose out of some experiments on the gradual heating of cupric acetate in a vacuum, an account of which had already appeared in the *Transactions*. Both cupric acetate and cupric formate when strongly heated in a glass vessel deposit a mirror of copper on the glass, showing that a gas containing copper has been formed. The temperature of decomposition of cuprous acetate is very near its temperature of volatilisation, and neither it nor cuprous formate can be obtained, except in very small proportion, by sublimation from the cupric salt.

*36. "The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds." By Harold Hartley and Noel Garrod Thomas.

Experiments were made on the crystallisation of triphenylmethane from a large number of organic liquids in order to see in what cases a crystalline compound is formed with the solvent. From benzene, thiophen, pyrrole, and aniline solutions, it crystallises under certain conditions with one molecule of the solvent, and a microscopic study of crystals of the four compounds has shown that they all belong to the rhombohedral system, forming an isomorphous series.

The solubility of triphenylmethane in each of the four liquids and also in pyridine has been determined by a modification of the method devised by Kuriloff. Weighed quantities of solvent and solute are sealed in small glass tubes, and these are placed in a water-bath. By varying the temperature of the bath, two temperatures can be determined, at the lower of which the last crystal left undissolved is growing, and at the upper the same crystal is dissolving. These temperatures are usually 0·4° to 0·5° apart and their mean has been taken as the temperature of saturation.

Experiments were also made on the spontaneous crystallisation of supersaturated solutions of triphenylmethane in each of the foregoing solvents by cooling solutions in sealed tubes after they had been heated sufficiently to destroy all crystalline nuclei. When the tubes were shaken during the cooling, crystallisation took place at definite temperatures. The results confirm the existence of a metastable region in which supersaturated solutions cannot crystallise spontaneously. The limit of this region where the solutions pass into the labile state and crystallise can be represented by a curve, for which Miers and Isaac have suggested the name "supersolubility curve." It runs approximately parallel to the solubility curve at a distance from it depending on the respective solvent and solute.

*37. "The spontaneous crystallisation of supersaturated solutions." By Harold Hartley.

The author discussed the different views of Ostwald and de Coppet on this subject in view of the experiments described in the preceding communication and those of Miers and Isaac (Proc., 1906, 22, 9). It was shown how the difference between metastable and labile solutions might be explained from the kinetic standpoint as a result of the increased solubility of the small crystals which must be first formed in a spontaneous crystallisation.

Discussion.

Professor Miers welcomed these investigations as new examples of the importance of the supersolubility curve, and called attention to the fact that the authors could not have established their results without a practical knowledge of crystallography.

Sir William Ramsay pointed out the analogy between the behaviour of crystallisable solution in the metastable and stable states with that of a super-heated liquid, and suggested that Mr. Hartley might derive some help by a study of such behaviour.

Mr. Hartley, in reply, said that small crystals besides being abnormally soluble must also have a lower melting point than larger individuals, and that this fact would explain the usual occurrence of superfusion. Mr. P. W. Robertson and he were just starting to investigate the conditions under which a number of pure organic substances crystallise spontaneously, and the former had suggested that the variation of melting point with the size of a crystal might explain some of the irregularities which had been observed in cryoscopic work with such solvents as thymol. Supersaturated solutions did not crystallise immediately on reaching the labile state unless they were vigorously shaken; thus the pull on the solution, which was suggested by Sir William Ramsay's analogy of the continuous isothermal as necessary to start crystallisation, was actually realised in the continuous production of fresh liquid surfaces.

*38. "Preparation and properties of some new tropeines." By Hooper Albert Dickinson Jowett and Archie Cecil Osborn Hann.

The object of this investigation was primarily to determine whether any difference in physiological action could be observed between tropeines containing a lactone grouping and their corresponding hydroxy-acid, similar to that recorded in the case of pilocarpine and pilocarpic acid (Marshall, *J. Physiol.*, 1904, **31**, 153). For this purpose, the tropeines of methylparaconic, terebic, and phthalidecarboxylic acids were prepared, when it was found that both terebyl- and phthalidecarboxyl-tropeines, which produce an atropine-like effect on the heart, lose this action after a molecular proportion of alkali has been added to the base, thus showing in aqueous and alkaline solution a difference in action analogous to that observed in the case of pilocarpine.

In addition to the tropeines already mentioned, the glycollyl- and protocatechyl-derivatives were prepared and the opportunity taken to test Ladenburg's generalisation. According to this chemist, a tropeine, in order to possess mydriatic action, must contain a benzene nucleus and a fatty hydroxyl attached to the same carbon atom as that bearing the carboxyl group. It was found that this did not strictly hold, as terebyltropeine possessed a distinct mydriatic action. It would appear, however, that the conditions most favourable for the development of the mydriatic action in a tropeine are those stated by Ladenburg, namely, that the acyl group should contain a benzene nucleus and an aliphatic hydroxyl in the side-chain containing the carboxyl group.

*39. "Studies in asymmetric synthesis. IV. The application of Grignard's reaction for asymmetric syntheses." By Alexander McKenzie.

The author has studied the action of magnesium propyl iodide, magnesium *iso*butyl iodide, and magnesium α-naphthyl bromide respectively on *l*-menthyl benzoylformate and effected in each case an asymmetric synthesis of a substituted *l*-glycollic acid. The influence of the *l*-bornyl as contrasted with that of the *l*-menthyl grouping was examined by acting on *l*-bornyl benzoylformate with various magnesium alkyl halides; the effect of the *l*-bornyl grouping was to diminish the lævorotation of the mixture of substituted glycollic acids obtained; thus, whilst the mixture of *d*- and *l*-atrolactinic acids obtained from *l*-menthyl benzoylformate and magnesium methyl iodide had $[\alpha]_D$ − 9·5° in ethyl-alcoholic solution, the mixture from *l*-bornyl benzoylformate under similar conditions gave $[\alpha]_D$ − 1·9°.

A mixture of *d*- and *l*-phenyl*iso*butylglycollic acids containing an excess of the *d*-acid was produced from *l*-bornyl benzoylformate and magnesium *iso*butyl iodide, whereas the mixture was lævorotatory when *l*-menthyl benzoylformate was used. Similarly, a dextrorotatory mixture of acids was produced by the action of *l*-bornyl benzoylformate on magnesium α-naphthyl bromide.

The asymmetric synthesis of *d*-atrolactinic acid was produced by the action of magnesium phenyl bromide on *l*-menthyl pyruvate.

When *l*-menthyl acetoacetate, *l*-menthyl ethylacetoacetate, or *l*-menthyl diethylacetoacetate is submitted to the Grignard reaction, no asymmetric synthesis occurs, the first of these substances reacting in accordance with its enolic structure. A slight asymmetric synthesis was, however, detected when *l*-menthyl lævulate was used.

40. "*o*-Cyanobenzenesulphonic acid and its derivatives."

By A. Jamieson Walker and Elizabeth Smith.

Reference was made to the work of Jesurun (*Ber.*, 1893, **26**, 2288) on *o*-cyanobenzenesulphonic chloride, and to that of Remsen and others (*Amer. Chem. J.*, 1895, **17**, 309 and 347; *ibid.*, 1896, **18**, 794 and 819) and List and Stein (*Ber.*, 1898, **31**, 1648) on ammonium *o*-cyanobenzenesulphonate.

The authors then described a modification of Jesurun's method for the preparation of *o*-cyanobenzenesulphonic chloride and the isolation from the mother liquor of o-*cyanobenzenesulphonic acid*, $CN\cdot C_6H_4\cdot SO_3H$, which crystallises from water in white needles melting at 279—279·5°. Its silver salt has been prepared, and the action of nitric acid and bromine on the acid investigated.

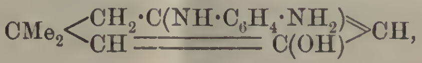
Reduction of the chloride with zinc dust yields o-*cyanobenzenesulphinic acid*, $CN\cdot C_6H_4\cdot SO_2H$, which crystallises in small, white needles melting at 226·5—228°. With bromine, this acid yields two compounds melting at 156—156·5° and 172·5—173° respectively, but containing no bromine. Their constitution is still being investigated. Nitrous acid converts the sulphinic acid into a yellow solid, probably o-*cyanodibenzsulphohydroxamic acid*, $N[C_6H_4(CN)\cdot SO_2]_2\cdot OH$.

Heating with dilute caustic soda and subsequent acidification transform the chloride into a substance (m. p. 221·5—223°) with the sweet taste of "saccharin," and not into the sulphonic acid.

41. "The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines. Part II. Diamines.—*m*- and *p*-Phenylenediamines." By Paul Haas.

Dimethyldihydroresorcin condenses, in alcoholic solution, with one molecular proportion of a diamine, giving an 80 per cent. yield of the compound

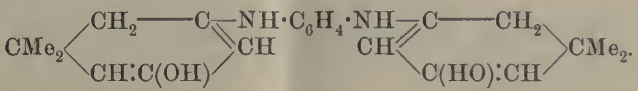
I.



$$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2\cdot C(NH\cdot C_6H_4\cdot NH_2)} \\ \mathrm{CH=\!=\!=\!=\!=C(OH)}\end{matrix}>\mathrm{CH},$$

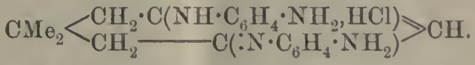
together with a small amount of a disubstituted amine having the formula

II.



A better yield of the latter substance is obtained by prolonged boiling in alcoholic solution of one molecular proportion of the compound I with a second molecule of dimethyldihydroresorcin. Chloroketodimethyltetrahydrobenzene condenses with two molecules of a primary diamine to give a hydrochloride having the following formula:

III.



$$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2\cdot C(NH\cdot C_6H_4\cdot NH_2,HCl)} \\ \mathrm{CH_2{-\!-\!-\!-}C(:N\cdot C_6H_4\cdot NH_2)}\end{matrix}>\mathrm{CH}.$$

The corresponding base is strongly alkaline to litmus, whereas the compound I has a neutral reaction; it cannot be made to condense further with dimethyldihydroresorcin as, owing to its strongly basic nature, it is precipitated by this substance from an alcoholic solution in the form of an insoluble resorcin salt having the formula

$$\mathrm{C_{20}H_{24}N_4,C_8H_{12}O_2}.$$

42. "A modification of the volumetric estimation of free acid in the presence of iron salts." By C. Chester Ahlum.

Because of the inapplicability of indicators in the titration of free acid in the presence of iron salts, the author devised a modification in which the iron is removed from solution, making a titration possible. The iron is precipitated by means of sodium dihydrogen phosphate. The iron phosphates are filtered off and the filtrate titrated with standard sodium hydroxide. In the reaction of the ferric salt with the sodium dihydrogen phosphate, a definite quantity of acid is liberated, necessitating a correction in the amount of acid found in the titration.

$$\mathrm{Fe_2(SO_4)_3 + 2NaH_2PO_4 = 2FePO_4 + Na_2SO_4 + 2H_2SO_4}.$$
$$\mathrm{Fe_2Cl_6 + 2NaH_2PO_4 = 2FePO_4 + 2NaCl + 4HCl}.$$

The amount of acid is directly proportional to the amount of ferric iron present, the latter being estimated previous to the titration. The difference between the amount of acid found in the titration and the amount of acid equivalent to the ferric iron present gives the true amount of free acid. A table giving the results of a number of estimations of free acid in mixtures of known quantities of ferric sulphate and sulphuric acid shows a considerable degree of accuracy.

Calcium, magnesium, and ferrous salts do not interfere with the estimation, and the method is applied to the analysis of natural waters containing iron salts and free acid.

43. "The theory of alkaline development, with notes on the affinities of certain reducing agents." By Samuel Edward Sheppard.

The author first dealt with the reactions of hydroxylamine and hydrogen peroxide respectively with silver salts, with notes on the reactions of organic reducers. It was shown that at moderate concentration one molecule of hydroxylamine reduces one molecule of silver salt, but at great dilutions two, according to the equations:

$$2NH_2{\cdot}OH + Ag_2O = 2Ag + N_2 + 3H_2O\ ;$$
$$2NH_2{\cdot}OH + 2Ag_2O = 4Ag + N_2O + 3H_2O,$$

whilst one molecule of hydrogen peroxide reduced one molecule of silver salt, probably according to the equation:

$$2H_2O_2 + Ag_2O = 2Ag + H_2O + 2O_2 + H_2,$$

hydrogen being one of the reaction products. The bearing on the molecular condition in solution of these substances was discussed. With organic reducers, such as polyphenols and aminophenols, a peculiar case of "coupled" reaction was examined, wherein the mutual presence of organic compound and sulphite retarded the total oxidation. The author has also investigated the dynamics of development with these reducers.

44. "Resolution of 2 : 3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides." By Allen Neville.

When ethyl benzylacetoacetate is treated with concentrated sulphuric acid, 3-methylindene-2-carboxylic acid is formed, which on reduction with sodium amalgam gives 2 : 3-dihydro-3-methylindene-2-carboxylic acid. This acid forms with *l*-menthylamine a well-defined crystalline salt, which on crystallisation from ethyl acetate gives, after a few crystallisations, the pure salts of the *d*-acid and *l*-base. This substance crystallises in long, white needles, melts at 170°, is easily soluble in all the ordinary organic media except ethyl acetate and ether, and has $[\alpha]_D$ +27·35° and $[M]_D$ +89·63°. On decomposing this salt, *d*-2 : 3-dihydro-3-methylindene-2-carboxylic acid was obtained, which crystallised in long, flat needles melting at 86°. It was insoluble in water, but soluble in all the ordinary organic media; it gave in alcohol $[\alpha]_D$ +67·28° and $[M]_D$ +118·41°, and in benzene $[\alpha]_D$ +76·86° and $[M]_D$ +135·27°. The *sodium*, *potassium*, *barium*, *silver*, and *lead* salts and the *methyl* ester were prepared.

From the more readily soluble portions of the menthylamine salt, the lævorotatory acid was isolated. This was exactly similar in specific rotation and other properties to the corresponding dextrorotatory isomeride.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Aaron, *C. H.* Assaying. 2 vols. pp. 142, 170. ill. San Francisco 1900. (*Recd.* 13/2/06.) From Bennett H. Brough, Esq.

Baeyer, *Adolf von.* Gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. 2 vols. pp. cxxxii + 990, 1195. Braunschweig 1905. (*Recd.* 13/2/06.) From the Publishers: Messrs. Vieweg & Son.

Baumert, *Georg*, **Dennstedt**, *M.*, und **Voigtländer**, *F.* Lehrbuch der gerichtlichen Chemie. Band II. Der Nachweis von Schriftfälschungen, Blut und Sperma. pp. x + 248. ill. Braunschweig 1906. (*Recd.* 13/2/06.) From the Publishers: Messrs. Vieweg & Son.

Bernthsen, *A.* Kurzes Lehrbuch der organischen Chemie. 9th edition. Edited by *Ernst* **Mohr**. pp. xxi + 638. Braunschweig 1906. (*Recd.* 13/2/06.) From the Publishers: Messrs. Vieweg & Son.

Crookes, *Sir William.* Select methods in chemical analysis (chiefly inorganic). 4th edition. pp. xxiv + 738. ill. London 1905. (*Recd.* 10/2/06.) From the Author.

—— The wheat problem. Based on remarks made in the presidential address to the British Association at Bristol in 1898. Revised with an answer to various critics. With two chapters on the future wheat supply of the United States, by *C. Wood* **Davis** and the Hon. *John* **Hyde**. 2nd edition. pp. xii + 229. London 1905. (*Recd.* 10/2/06.) From the Author.

Faust, *Edwin Stanton.* Die tierischen Gifte. pp. xiv + 248. Braunschweig 1906. (*Recd.* 13/2/06.)
From the Publishers: Messrs. Vieweg & Son.

Goppelsroeder, *Friedrich.* Anregung zum Studium der auf Capillaritäts- und Adsorptionserscheinungen beruhenden Capillaranalyse. pp. 239. Basel 1906. (*Recd.* 19/1/06.) From the Author.

Ostwald, *Wilhelm.* Conversations on chemistry. Part II. The chemistry of the most important elements and compounds. Authorised translation by *Stuart K.* **Turnbull.** pp. viii + 373. ill. New York. 1906. (*Recd.* 30/1/06.) From the Publishers : Messrs. Wiley & Sons.

Parry, *Laurent.* Die analytische Bestimmung von Zinn und Antimon. pp. 78. Leipzig 1906. (*Recd.* 13/2/06.)

From Bennett H. Brough, Esq.

II. *By Purchase.*

Bio-chemical Journal. Edited by *Benjamin* **Moore** and *Edward* **Whitley.** Vol. I, No. 1. Liverpool 1906. (*Reference.*)

Czapek, *Friedrich.* Biochemie der Pflanzen. 2 vols. pp. xv + 584, xii + 1027. Jena 1905. (*Recd.* 13/2/06.)

Moeller, *Josef.* Mikroskopie der Nahrungs-und Genussmittel aus dem Pflanzenreiche. 2nd edition. pp. xvi + 599. ill. Berlin 1905. (*Recd.* 13/2/06.)

Stillman, *Thomas B.* Engineering chemistry : a manual of quantitative chemical analysis. 3rd edition. pp. xxii + 597. ill. Easton, Pa. 1905. (*Recd.* 2/2/06.)

Treadwell, *F. P.* Analytical chemistry. Volume I. Qualitative analysis. Translated by *William T.* **Hall.** pp. xi + 466. ill. New York 1905. (*Recd.* 27/1/06.)

Wieler, *A.* Untersuchungen über die Einwirkung schwefliger Säure auf die Pflanzen. pp. vii + 427. ill. Berlin 1905. (*Recd.* 13/2/06.)

III. *Pamphlets.*

Baker, *Richard T.*, and **Smith**, *Henry G.* Some West Australian eucalypts and their essential oils. (From the *Pharm. J.*, **21**, 1905.)

Juritz, *Charles F.* The need for organised chemical research in the Cape Colony. pp. 23. Cape Town [1905].

—— Some notes regarding South African pharmacology. (From the *Trans. S. African Phil. Soc.*, **16**, 1905.)

Smith, *Henry G.* The refractive indices, with other data, of the oils of 118 species of eucalyptus. (From the *J. and Proc. Roy. Soc. N.S. Wales*, **39**, 1905.)

—— On the occurrence of calcium oxalate in the barks of the eucalypts. (From the *J. and Proc. Roy. Soc. N.S. Wales*, **39**, 1905.)

At the next Ordinary Meeting, on **Thursday**, March **1st**, 1906, at **8.30** p.m., the following paper will be communicated:

"Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor." By T. M. Lowry.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 9/3/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. **No. 306.**

Thursday, March 1st, 1906, at 8.30 p.m. Mr. A. G. VERNON HARCOURT, F.R.S., Past President, in the Chair.

Messrs. A. T. Braid, H. E. Fierz, W. P. Hayworth, H. A. D. Neville, F. W. Walker, E. Wechsler, and J. L. White were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Edwin Rodney Chrystall, Forest Villa, Prince's Road, Buckhurst Hill, Essex.
Robert K. Duncan, University of Kansas, U.S.A.
Ernest Feilmann, B.Sc., Ph.D., F.I.C., 2A, Dartmouth Road, Brondesbury, N.W.
James Louis Foucar, B.Sc., 20, St. John's Park, Blackheath, S.E.
Richard John Hall, M.Sc., F.I.C., "Sandycroft," Serpentine Road, Egremont, Liverpool.
Walter Daly Scouller, B.Sc., 7, Stamp Office Place, Wakefield.
James Frederick Spencer, M.Sc., Ph.D., 134, Rice Lane, Walton, Liverpool.
Francis W. Storey, B.Sc., 42, Ellerdale Street, Lewisham, S.E.
George Augustus Turner, " Alma House," Strandtown, Belfast.

A certificate has been authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of :

Hem Chandra Dutt Gupta, "Guptanibar," Krishnagar, Bengal, India.

Of the following papers, those marked * were read:

*45. "Studies of dynamic isomerism. Part IV. Stereoisomeric halogen derivatives of camphor." By Thomas Martin Lowry.

Measurements were given of the solubility in alcohol of α-chloro- and α-bromo-camphors, $\alpha\beta$- and $\alpha\pi$-dibromocamphors, and $\alpha\beta$- and $\alpha\pi$-chlorobromocamphors, both alone and in presence of a small proportion of sodium ethoxide. In each case it was found that the addition of alkali resulted in an increase of solubility in the ratio of about 0·9 to 1. No such increase was observed in the case of β-bromocamphor, or of compounds in which both the α- and α'-hydrogen atoms were displaced. The increase of solubility is ascribed to the formation in the solution of a small proportion (7 to 12 per cent.) of the stereoisomeric α'-compound (compare Kipping, Proc., 1905, **21**, 124 and 125).

*46. "The coagulating action of colloids. Part I." By William Porter Dreaper and Alexander Wilson.

The addition of tannic acid to an organic colloid like gelatin or albumin in the hydrosol state determines the amount of gallic acid absorbed by the coagulum. The gallic acid may be present before or after the addition of tannic acid. Acids like hydrochloric or acetic reduce this absorption. Salts, on the other hand, increase it. These acids do not seem to replace the gallic acid by mass action or otherwise.

Gelatin in the hydrogel state absorbs gallic acid, although no precipitation takes place if the former is in the hydrosol state. Salts increase absorption, but alcohol reduces it.

Albumin absorbs gallic acid when precipitated by either tannic acid or heat. Alcohol prevents this action and also the absorption of tannic acid by albumin. Addition of gallic acid to a "solution" containing tannic acid and albumin causes rapid coagulation. This reaction is dependent on concentration. In very concentrated solutions, gallic acid will precipitate albumin.

Absorption by silk is greatly reduced in presence of alcohol, the tannic acid absorbed is reduced from 15 to 1·2 per cent. Hide powder behaves in a similar way, the tannic acid absorbed being reduced from 72 to 10 per cent.

Solutions of gelatin, "collin," and albumin give these reactions.

The results obtained by the author throw further light on dyeing and tanning processes. The influence of gallic acid in the manufacture of leather seems to be of a more direct nature than was previously supposed.

DISCUSSION.

Mr. DREAPER, in reply to questions from Dr. Cain, stated that "collin" was a form of soluble gelatin used by Parker and Payne in the estimation of tannic acid; it did not enter the hydrogel state at the ordinary temperature.

The tannic and gallic acids were estimated by the process he had suggested some time ago. The tannic acid was titrated with copper sulphate solution in the presence of calcium carbonate. The separation of the two acids was brought about by precipitating the former as lead tannate in the presence of a definite excess of acetic acid, which prevented the gallate being precipitated at the same time. The gallic acid in the filtrate was then estimated as copper salt.

*47. "Studies on optically active carbimides. III. The resolution of α-phenyl-α′-4-hydroxyphenylethane by means of *l*-menthylcarbimide." By Robert Howson Pickard and William Oswald Littlebury.

A method of resolving racemic hydroxyl compounds by means of *l*-menthylcarbimide was described. The *l*-menthylcarbamates thus obtained by the combination of these compounds can be separated by fractional crystallisation and are then hydrolysed by alcoholic sodium hydroxide. d-*α-Phenyl-α′-4-hydroxyphenylethane* l-*menthylcarbamate* separates in a pure condition from light petroleum and melts at 117°. When hydrolysed, it yields d-*α-phenyl-α′-4-hydroxyphenylethane*, which melts at 64° and has $[\alpha]_D$ $+7{\cdot}78^\circ$ in benzene.

DISCUSSION.

Dr. A. MCKENZIE asked whether the authors had obtained any evidence of the partial resolution of an inactive phenol into its optical isomerides by the action of an amount of *l*-menthylcarbimide insufficient for complete interaction. A partial resolution might be expected to occur under such conditions if the velocity of interaction of the *d*-phenol with the *l*-carbimide were different from that of the *l*-phenol. That an inactive alcohol may be partially resolved into its optical isomerides has been shown with *sec*-octyl alcohol (*Ber.*, 1901, **34**, 474).

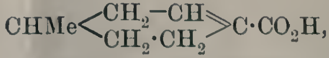
It would be interesting to know whether the temperature conditions under which the fractional crystallisation described by the authors took place had much influence on the progress of the resolution.

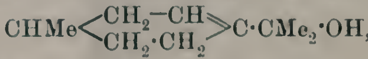
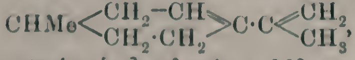
Dr. PICKARD, in reply to a question from Dr. Forster, stated that the method of obtaining carbimides by the action of nitrous acid on the corresponding carbamides could not be used for the preparation of *l*-menthylcarbimide, as this reacts too readily with water.

In reply to Dr. McKenzie, he said that in attempting the resolution of α-phenyl-α′-4-hydroxyphenylethane by treatment with half its equivalent of *l*-menthylcarbimide, some experimental difficulties supervened and led to the adoption of the easier method of fractionally crystallising a mixture of the two modifications of the *l*-menthylcarbamates. No evidence of a transition temperature was observed during the investigation.

*48. "Experiments on the synthesis of the terpenes. Part VIII. Synthesis of the optically active modifications of Δ^3-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene." By Francis William Kay and William Henry Perkin, jun.

The terpenes and their derivatives, which have so far been obtained synthetically (*Trans.*, 1904, **85**, 654; 1905, **87**, 639, 655, 661, 1067, and 1083; Proc., 1905, **21**, 255), have always been inactive, but the following optically active members belonging to this group have now been synthesised.

Δ^1-*Tetrahydro*-p-*toluic acid*,  $CHMe{<}{\begin{smallmatrix}CH_2-CH\\CH_2\cdot CH_2\end{smallmatrix}}{>}C\cdot CO_2H$, contains an asymmetric carbon atom, and by the systematic crystallisation of its brucine and strychnine salts the authors have resolved it into its dextro- and lævo-modifications. The lævo-modification obtained from the brucine salt has a rotation of $[\alpha]_D$ − 100°, whereas the dextro-acid obtained from the strychnine salt has a corresponding rotation of $[\alpha]_D$ + 101°.

The esters of these acids were prepared by the action of alcoholic sulphuric acid; *ethyl* d-Δ^1-*tetrahydro*-p-*toluate* boiled at 154°/100 mm. and had $[\alpha]_D$ + 86°, the lævo-modification boiled at 154°/100 mm. and had $[\alpha]_D$ − 84°. On treating the latter with the theoretical amount of magnesium methyl iodide and then decomposing with water and dilute acid, l-Δ^3-p-*menthenol*(8),  $CHMe{<}{\begin{smallmatrix}CH_2-CH\\CH_2\cdot CH_2\end{smallmatrix}}{>}C\cdot CMe_2\cdot OH$, was obtained; this substance boils at 101°/14 mm. and has $[\alpha]_D$ − 67°. When this menthenol is digested with potassium hydrogen sulphate, partial racemisation takes place, and the resulting $\Delta^{3\cdot 8(9)}$-p-*menthadiene*,  $CHMe{<}{\begin{smallmatrix}CH_2-CH\\CH_2\cdot CH_2\end{smallmatrix}}{>}C\cdot C{<}{\begin{smallmatrix}CH_2\\CH_3\end{smallmatrix}}$, which distils at 185°/748 mm., has a rotation $[\alpha]_D$ of only − 10°.

Pure d-$\Delta^{3\ 8(9)}$-p-*menthadiene* was, however, obtained by the direct action of excess of magnesium methyl iodide on the *d*-ester without the aid of the acid sulphate; it boils at 184—186°/756 mm. and has $[\alpha]_D$ +98°. The magnetic rotations and other physical constants of these interesting substances are being determined.

*49. "Studies in the acridine series. III. The methylation of chrysaniline." By Albert Ernest Dunstan and John Theodore Hewitt.

The authors have continued the research on the lines laid down by Hewitt and Fox (*Trans.*, 1904, **85**, 529, and 1905, **87**, 1058), and have prepared the diacetyl and tetra-acetyl derivatives of chrysaniline, starting from the purified base.

By treatment with methyl iodide and methyl alcohol, the diacetyl derivative afforded an acridinium methiodide, which on hydrolysis immediately gave an anhydro-base; this substance was also prepared by the use of methyl sulphate and subsequent hydrolysis and precipitation with ammonia.

50. "Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c." By Thomas Edward Thorpe.

Known quantities of the material, as a rule about 2 grams, are moistened with lime water, mixed with calcined magnesia, dried, and charred. The ash is treated with dilute sulphuric acid, half a gram of potassium metabisulphite added, the solution boiled and diluted to a definite volume, and the whole or an aliquot portion, depending on the amount of arsenic suspected to be present, is added to the electrolytic arrangement already described (*Trans.*, 1903, **83**, 974). The deposit of arsenic so obtained is then compared with deposits obtained in precisely the same way by the addition of known quantities of arsenic, ranging from 0·005 to 0·0125 milligram of arsenious oxide, to materials free from arsenic, as in the method of testing brewing materials for arsenic already described (*loc. cit.*). A single incineration of the suspected material suffices for several tests. The amounts of lime-water and magnesia recommended to be used have been proved by direct experiment to retain amounts of arsenic ranging from 0·0025 to 5 milligrams when contained in 2 grams of wool or paper.

Many samples of woollen materials met with in commerce contain very notable quantities of arsenic, arising probably from the widespread use of arsenical dips.

51. "Nitrogen halides from camphoryl-ψ-carbamide." By Martin Onslow Forster and Hans Grossmann.

The action of potassium hypobromite and hypochlorite on camphoryl-ψ-carbamide has been found to give rise to dihalogen derivatives which have all the properties of compounds containing halogen attached to nitrogen. Normal camphorylcarbamide yields the same substances, owing to the readiness with which it changes into the *pseudo*-modification under the influence of alkalis. Corresponding monohalogen derivatives have been obtained from camphorylmethyl-ψ-carbamide and its normal modification.

52. "The relation of position isomerism to optical activity. VI. The rotation of the menthyl esters of the isomeric chloronitrobenzoic acids." By Julius Berend Cohen and Henry Percy Armes.

It was pointed out in a previous paper on this subject (*Trans.*, 1905, 87, 1192) that whereas chlorine and bromine atoms in the ortho-position to the active group lower its rotation, the nitro-group has the opposite effect of greatly increasing it. In the present investigation, the combined effect of halogen and nitro-group on the activity of the menthyl group has been examined. The authors have studied the rotations of eight out of the ten isomeric chloronitrobenzoic esters, the 2-chloro-3-nitro- and 3-chloro-2-nitro-compounds being omitted owing to difficulties of preparation.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Löb, *Walther.* Electrochemistry of organic compounds. Authorised translation from the 3rd edition by *H. W. F.* **Lorenz**. pp. x + 308. ill. New York 1906. (*Recd.* 28/2/06.)

From the Publishers: Messrs. Wiley & Sons.

Stas, *Jean Servais.* Untersuchungen über die Gesetze der chemischen Proportionen, über die Atomgewichte und ihre gegenseitigen Verhältnisse. Uebersetzt von *L.* **Aronstein**. pp. xii + 347. Leipzig 1867. (*Recd.* 15/2/06.) From Dr. A. Scott, F.R.S.

II. *By Purchase.*

Low, *Albert H.* Technical methods of ore analysis. pp. x + 273. ill. New York 1905. (*Recd.* 20/2/06.)

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and Council and other business will be held on **Friday, 30th March, 1906, at 5 o'clock** in the afternoon.

The President will deliver his address entitled: "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

At the next Ordinary Meeting, on **Thursday**, March **15th**, 1906, at **8.30** p.m., the following papers will be communicated:

"The interaction of well-dried mixtures of hydrocarbons and oxygen." By W. A. Bone and G. W. Andrew.

"The explosive combustion of hydrocarbons." By W. A. Bone and J. Drugman.

"The occurrence of marsh gas amongst the decomposition products of certain nitrogenous bases as a source of error in the determination of nitrogen by the absolute method." By P. Haas.

"Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution." By P. W. Robertson.

"The displacement of acid radicles. I. Displacement of the chloride and nitrate radicles." By A. F. Joseph.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 22/3/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 307.

Thursday, March 15th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. S. L. Courtauld, L. H. Durrans, and R. W. L. Clarke were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Ernest Barrett, B.Sc., 56, Elswick Road, Lewisham, S.E.
Percy Garratt Chamberlain, M.A., 3, Market Place, Rugby.
Cecil Wyatt-Edgell, B.A., Cowrey Place, Exeter.
O. Bertram Foy, 16, Burlington Road, Dublin.
John Adam Watson, 8, Powis Gardens, Notting Hill, W.

A certificate has been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of :

Ram Chandra Mukerjee, B.A., of Jaipur, Rajputana, India.

The PRESIDENT announced that Dr. G. T. Morgan had found it necessary to resign the Editorship of the Society's publications, and the Council had appointed Dr. J. C. Cain to succeed him.

Attention was drawn to the fact that the Sixth International Congress of Applied Chemistry will be held in Rome, beginning on April 25th, 1906.

Of the following papers, those marked * were read:

*53. "The interaction of well-dried mixtures of hydrocarbons and oxygen." By William Arthur Bone and George William Andrew.

The results of experiments carried out chiefly with mixtures of ethylene and oxygen, well dried by previous long contact with redistilled phosphoric oxide, do not support the view that the presence of steam is essential to the combustion of a hydrocarbon. It was shown that an amount of desiccation which almost inhibits the combination of hydrogen and oxygen (electrolytic gas) at 525° does not appreciably retard the oxidation of ethylene. The authors therefore conclude that oxygen is directly active in hydrocarbon combustion.

*54. "The explosive combustion of hydrocarbons."
By William Arthur Bone and Julien Drugman.

The authors showed, as the result of an exhaustive study of the explosive combustion of a number of different gaseous hydrocarbons, including paraffins up to butane and olefines such as ethylene, propylene, and the butylenes, that the theory of the preferential combustion of carbon completely breaks down when applied to hydrocarbon flames. The results of the research constitute a strong argument in favour of the view that there is no essential difference between the slow and rapid combustion of a hydrocarbon, and that explosive combustion probably involves the initial formation of unstable hydroxylated molecules, which subsequently undergo thermal decomposition into simpler products. Very striking differences as regards the composition of the end-products are obtained when explosive combustion occurs in the system $C_xH_y + x/2O_2$, according as the hydrocarbon is a paraffin or an olefine. In the case of a paraffin, there is always a separation of carbon and a large formation of steam, whereas in the case of the corresponding olefine there is no separation of carbon, and the cooled products consist almost entirely of carbon monoxide and hydrogen in accordance with the empirical equation $C_nH_{2n} + n/2O_2 = nCO + nH_2$. In the case of an olefine, it was shown that on reducing the proportion of oxygen much below that indicated by the expression $C_nH_{2n} + n/2O_2$, not only does carbon separate in the flame, but also a large formation of steam occurs, a result which is quite incompatible with the theory of the preferential combustion of carbon in hydrocarbon flames.

Comparative experiments on the explosion of mixtures corresponding to $C_2H_6+O_2$, $C_2H_4+H_2+O_2$, and $C_2H_2+2H_2+O_2$ respectively prove that the process cannot be regarded as involving the primary dissolution of the hydrocarbon, followed by a distribution of the oxygen between free carbon and hydrogen.

Incidentally, it was shown that the affinity of hydrocarbons for oxygen at high temperatures is enormously greater than that of hydrogen, so that whenever mixtures of hydrocarbons and hydrogen react with a supply of oxygen less than is required to complete the initial combustion stages of the hydrocarbon, the latter is burnt almost to the entire exclusion of the hydrogen. Hence, in hydrocarbon flames, the initial stages of the oxidation of the hydrocarbon probably take precedence of all other chemical processes.

DISCUSSION.

Professor SMITHELLS said that he was very ready to confess any mistake he might have made in giving currency to the idea of a "preferential oxidation" of carbon in the combustion of hydrocarbons. He admitted at once that the expression was not universally applicable, and he would endeavour in future not to use it without the necessary qualifications. He wished, however, to remind Fellows what the history of the matter really was. When he began to experiment with flames, he was under the conviction, which he believed was shared by chemists in general, that when a hydrocarbon was burned with a restricted supply of oxygen, carbon rather than hydrogen would remain unoxidised. That view lay at the root of the explanation of the luminosity of hydrocarbon flames then current. When, experimenting with the aërated flame of ethylene, he had found that the interconal gases contained a large quantity of free hydrogen and no unoxidised carbon, and when he had found this to be true of hydrocarbon flames in general, he felt that a complete revolution must be made in our views, and it was then that he used the expression preferential combustion of carbon. In describing chemical changes, it was customary to name the substances used and the substances ultimately obtained. Whatever transitory products might be formed, however the mechanism might be regarded, it was the custom to say, for example, that zinc and strong sulphuric acid give sulphur dioxide, zinc sulphate, and water. We might suppose that zinc first displaced hydrogen from the acid and that the hydrogen reduced some more of the acid, or that the zinc was oxidised by the acid and the oxide then dissolved in more acid. Then, again, hydrogen sulphide and free sulphur were to some extent formed. In such an apparently simple reaction as this, we could affirm nothing with certainty about the actual mechanism. Therefore, we said simply that zinc and sulphuric acid give sulphur dioxide, water, and zinc sulphate. In like manner, it might be said that in the case of hydrocarbon flames burning with a restricted supply of oxygen the carbon was preferentially oxidised.

With regard to the probable course of the oxidation, he considered that Dr. Bone had made out a very strong case. It was undoubtedly possible that all the stages which the author had indicated might be passed through; he did not think the explanation presented great difficulties from the standpoint of the kinetic theory of gases. On the other hand, it was undoubtedly possible that the final condition of equilibrium might be reached in one bound, just as a stone under impulse might reach the foot of a hill in one bound instead of following the contour of the slope. It was a question of the balance of evidence. The most serious piece of experimental evidence he knew against Dr. Bone's view was that in those parts of a flame where the partial combustion of hydrocarbons is taking place there is to be seen a spectrum which he believed to be only known where carbon and oxygen were uniting to form carbon monoxide. That spoke for a direct attack of the oxygen on the carbon. The solution of the question was one of extreme difficulty, and, as he had said, it involved the careful weighing of circumstantial evidence.

Having dealt, Dr. ARMSTRONG said, with Dr. Bone's work elsewhere, and being in agreement with him on the main issue, there were but few matters to which he need refer. One of the most striking points brought before them was the incombustibility of hydrogen as compared with hydrocarbons—he thought that it would have to be recognised that hydrogen was not the active, attractive element it was commonly supposed to be in hydrogen compounds, but that more often than not it simply became pushed aside, as it were. The carbon appeared to be primarily the attractive element, and in this restricted sense Professor Smithells was justified in speaking of the preferential combustion of the carbon in hydrocarbons. As to the influence of moisture on the combustion of hydrocarbons, it was to be expected that a hydrocarbon-oxygen mixture would be much more sensitive to change than one of hydrogen and oxygen. Such questions *must* be regarded from the point of view of some consistent theory of chemical change; it would be very difficult to obtain direct experimental proof that conducting water was essential to the occurrence of the combustion. The view he had expressed twenty years ago in that room, that a mixture of hydrogen and oxygen alone would be found to be incombustible, was now accepted, however, and he did not hesitate to assert that it was necessary to extend the argument from hydrogen to hydrocarbons but would not be surprised if another twenty years passed before it were recognised that a mixture consisting simply of a hydrocarbon and oxygen was incombustible.

Dr. Bone, in reply, remarked that the discussion had not elicited any definite criticism of the views he had advanced in the paper. His own position was simply this. In conjunction with Dr. Drugman, he had discovered certain facts which proved that preferential combustion of carbon did not take place in hydrocarbon flames, but which could be perfectly well explained on the supposition that hydroxylated or oxygenated molecules were initially formed. He had endeavoured to form a mental picture of the processes going on in the flame, but, beyond expressing the conviction that the oxygen is in some way actually incorporated with the hydrocarbon before the system breaks down into simpler products, he did not wish to put forward any theory otherwise than as a working hypothesis.

*55. "The occurrence of methane amongst the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method." By Paul Haas.

The gas collected over caustic potash in a Schiff's nitrometer during the estimation of nitrogen by the absolute method was found in the case of more than twelve different compounds to contain methane. The accumulation of this gas was prevented by replacing the copper oxide ordinarily used in such analyses by lead chromate, which effectually oxidises any methane formed.

Discussion.

Mr. Carr remarked that the different results obtained when the base or its hydrochloride are burnt and the inhibitive influence of cuprous chloride confirmed the results obtained by Prof. Dunstan and himself. These experiments had shown that methane can only be burnt with great difficulty by passing it over strongly heated copper oxide. From the evidence now adduced he thought that the use of cuprous chloride in determinations of nitrogen by the absolute method should become general. More methane is obtained by the "carbon dioxide" method than by Frankland and Armstrong's vacuum method.

Mr. W. A. Davis stated that in 1896, shortly after the publication of Prof. Dunstan and Mr. Carr's results, he had found that 1-nitro-2-methoxynaphthalene gave abnormally high results for nitrogen estimated by the absolute method and that the "nitrogen" collected was inflammable. The numbers obtained with the substance agreed closely with those required for a dinitro-derivative, but the fact that normal results were obtained with the derived 1-amino- and 1-acetylamino-2-methoxynaphthalene clearly established the true nature of the compound. It was doubtful whether the formation of methane could be attributed to any special structure, but it seemed, under exceptional conditions, to be associated with the presence of a methyl or methoxyl group.

Dr. Bone said that, with regard to combustions over a hot surface of copper oxide, he had found that the rate of disappearance of hydrogen when electrolytic gas, $2H_2+O_2$, was circulated over copper oxide at 200° was only about 1/30th of the corresponding rate when a mixture of $2H_2+N_2$ was employed. The oxygen in the electrolytic gas was condensed on the hot surface, forming a film which actually protected the copper oxide from the reducing action of hydrogen. Possibly other gases would be similarly condensed on the surface. He was not at all sure that the usual practice of using oxygen instead of air in ordinary combustion analyses over copper oxide was a good one.

56. "Studies on comparative cryoscopy. Part IV. The hydrocarbons and their halogen derivatives in phenol solution." By Philip Wilfred Robertson.

The hydrocarbons and their halogen derivatives are characterised by the fact that they give low molecular depressions, which decrease slowly with the concentration. This phenomenon appears to be intimately connected with the association of the solvent, as it is not exhibited to the same extent by the less associated substituted phenols, *o*-cresol, thymol, guaiacol, and *o*-nitrophenol.

It is also shown that benzene does not differ in behaviour from the other hydrocarbons examined, and hence its low molecular depression cannot be attributed to the formation of a solid solution, as Bruni endeavours to prove (*Gazzetta*, 1898, **28**, i, 249). By employing van Bijlerts' method, his results show that the benzene forms a 30 per cent. solid solution in the phenol. From this it is concluded that van Bijlerts' method is not always trustworthy, and, moreover, it is not justifiable to assume the existence of a solid solution when the observed molecular depression differs only slightly from the theoretical.

57. "The displacement of acid ions. Part I."
By Alfred Francis Joseph.

The author described his investigations on the quantitative action of hydrochloric acid on the nitrates of potassium, sodium, and strontium, and of nitric acid on the corresponding chlorides. An equivalent of the salt in aqueous solution is mixed with x equivalents of the acid, the mixture evaporated to dryness on the water-bath, and the proportion of chloride in the residue determined by titration with standard silver nitrate solution.

If the quantity of salt transformed be y, then it is found that the equation $y = a \log_{10} x + b$ holds good over a considerable range of values of x, a and b being constants depending on the particular acid and salt used. These constants increase and decrease simultaneously with the ratio of the solubilities of the two salts concerned in the transformation. It was found that to transform half the nitrate into chloride by one evaporation with hydrochloric acid requires about 1·5 equivalents of acid in the case of sodium nitrate, 2·9 for potassium nitrate, and 12 for strontium nitrate.

On the other hand, to transform nine-tenths of the chloride into nitrate requires 1·6 equivalents of nitric acid in the case of sodium chloride, 1·4 for potassium chloride, and 1·05 for strontium chloride.

58. "Additive compounds of arylamines with aromatic nitro-derivatives." * By Charles Loring Jackson and Latham Clarke.

The following additive compounds have been prepared by the authors in addition to those already described (*Ber.*, 1904, **37**, 176).

4 : 6-*Dibromo*-1 : 3-*dinitrobenzene dimethylaniline*,

$$2C_6H_2Br_2(NO_2)_2,C_6H_5 \cdot NMe_2,$$

which is precipitated as a heavy, red oil. When alcohol is added to a solution of the nitro-compound in an excess of dimethylaniline, it quickly solidifies to short, deep red prisms melting at 50°.

0·3487 gave 0·3373 AgBr. Br = 41·12.
0·1762 ,, 0·1705 AgBr. Br = 41·16.
$C_{20}H_{15}O_8N_5Br_4$ requires 41·39 per cent.

The compound is extremely unstable and readily loses dimethylaniline when exposed to the air.

4-*Chloro*-1 : 3 : 5-*tribromo*-2 : 6-*dinitrobenzene dimethylaniline*,

$$C_6ClBr_3(NO_2)_2,2C_6H_5 \cdot NMe_2,$$

obtained in the same way as the preceding compound, crystallises in slender, yellow needles and melts at 105°.

0·086 gave 0·0889 AgCl and AgBr ; Cl + Br = 40·25.
$C_{20}H_{11}O_8N_5Cl_2Br_6$ requires Cl + Br = 40·43 per cent.

The following compounds give red colorations with dimethylaniline; in certain cases the colour is removed by the addition of solvents, and in no case has a definite crystalline additive compound been isolated. Nitrobenzene, α-nitronaphthalene, *o*-nitrophenol, *m*-dinitrobenzene, 4-bromo-1 : 3-dinitrobenzene, 4 : 6-di-iodo-1 : 3-dinitrobenzene, 1 : 3 : 5-trichloro-2 : 4-dinitrobenzene, 4-bromo-3 : 5-dinitrobenzoic acid (which yields a salt melting at 120—125°), 4-ethoxy-3 : 5-dinitrobenzoic acid, 4-*iso*amyloxy-3 : 5-dinitrobenzoic acid, and picric acid.

---

* The investigations on additive compounds of trinitrobenzene with amines formerly described (*Ber.*, 1904, **37**, 176) and in this paper were undertaken before a copy of J. J. Sudborough's second paper (*Trans.*, 1903, **83**, 1334) had been received by the authors, who thereupon discontinued their experiments.

Methylaniline and *s*-trichlorotrinitrobenzene yield an unstable *additive compound*, which crystallises in red plates melting at about 78°; it becomes colourless when exposed to the air or when washed with ether, chloroform, or acids.

Several of the compounds of toluidines with trinitrobenzene and trinitrotoluene have been prepared (compare Hepp, *Annalen*, 1882, **215**, 344; Noelting and Sommerhoff, *Ber.*, 1906, **39**, 76). The compounds with trinitrotoluene are much less stable than those with trinitrobenzene.

The *additive compound* of *p*-toluidine and trinitrotoluene, which Sommerhoff could not obtain, may be prepared by fusing a mixture of the two components, adding a very small amount of toluene, and allowing to cool; it crystallises in dark red needles melting at about 68°.

0·2845 gave 41·4 c.c. of moist nitrogen at 20° and 768 mm. N = 16·82.

$C_{14}H_{14}O_6N_4$ requires N = 16·76 per cent.

s-Trichlorotrinitrobenzene and pyridine form an extremely unstable *additive compound*, $C_6Cl_3(NO_2)_3,C_6H_5N$, which crystallises in slender, red crystals.

0·1232 gave 0·1224 AgCl. Cl = 24·56. $C_{11}H_5O_6N_4Cl_3$ requires 26·87 per cent.

When kept for a short time, this substance sets to a black resin.

59. "Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines." By John Joseph Sudborough and Norman Picton.

The formation of additive compounds between α- or β-naphthylamine and *s*-trinitrobenzene derivatives is completely inhibited by the introduction of three methyl-, two methoxy-, or three bromo-radicles into the trinitrobenzene molecule. *s*-Trichlorotrinitrobenzene, however, is still capable of combining with α-naphthylamine. Various additive compounds are described.

The compounds derived from the naphthylamines and chloro-derivatives of the di- and tri-nitrobenzenes readily lose hydrogen chloride, yielding condensation products of the type of picryl-β-naphthylamine, $C_6H_2(NO_2)_3\cdot NH\cdot C_{10}H_7$. Several compounds of this type have been examined and the following points established: (1) most of the compounds exist in two distinct modifications, namely, a sulphur-yellow and a bright red variety. These may be mutually transformed one into the other by simple methods. (2) They form monopotassium salts which are readily hydrolysed by water. (3) They do not yield acetyl derivatives. (4) Some form extremely unstable additive compounds with arylamines. (5) It has not been found possible to replace the one arylamino-group, $\cdot NH\cdot C_6H_5$ for example, by another, such as $\cdot NH\cdot C_{10}H_7$.

60. "The relations between absorption spectra and chemical constitution. Part IV. The reactivity of the substituted quinones." By Alfred Walter Stewart and Edward Charles Cyril Baly.

The reactive power of carbonyl groups in quinones has been shown by Kehrmann (*Ber.*, 1888, **21**, 3315; *J. pr. Chem.*, 1889, [ii], **39**, 399; **40**, 257) to be greatly influenced by the replacement of the hydrogen atoms of the quinone nucleus by methyl radicles or halogen atoms. This has hitherto been explained on the assumption that such substituents sterically hinder the reactions of the carbonyl group in the ortho-position to which they lie. It appeared to the authors that a better explanation might be found in the influence of the substituents on the isorropic process in which the quinone carbonyls are concerned.

An examination was made of the absorption spectra of the following quinones: *p*-benzoquinone, toluquinone, *p*-xyloquinone, thymoquinone, chlorobenzoquinone, bromobenzoquinone, 2:6-dichlorobenzoquinone, trichlorobenzoquinone, trichlorotoluquinone, dibromothymoquinone, and dichlorothymoquinone; and from these spectra the following facts may be deduced. (1) Benzoquinone has an isorropic band of long persistence, and shows no sign of benzenoid structure; (2) the introduction of methyl radicles or of halogen atoms tends to diminish the persistence of the isorropic band and to produce in the spectrum a benzenoid band, the change being greater with chlorine than with methyl; (3) the benzenoid character of the compound is intensified in proportion to the decrease in the isorropic band.

From these facts the following conclusions may be drawn. Benzoquinone exists almost entirely in the quinonoid form. Toluquinone, while existing to a great extent in the quinonoid form, possesses certain characteristics of benzene and probably vibrates in a manner similar to that in which the benzene molecule oscillates. Chlorobenzoquinone, although still possessing certain quinonoid properties, is in a state of vibration approximating more closely to the intramolecular motions of benzene. Trichlorobenzoquinone, in which the isorropic process is practically non-existent, vibrates in a manner closely resembling the vibrations of the benzene ring.

Now Kehrmann has shown that the introduction of methyl radicles or halogen atoms hinders the formation of quinoneoximes, and the amount of hindrance observed by him is in complete accord with the change in character from the quinonoid to the benzenoid type which is proved by the spectroscopic evidence. In their previous papers (this vol., p. 33), the authors showed that in order to bring about the isorropic process the quinonoid structure had first to be produced. As the reactivity of the carbonyl group depends on the isorropic process, it is evident that the benzenoid character of the compounds examined is alone sufficient to explain their non-reactivity, without introducing the question of a purely hypothetical "steric hindrance." The facts now submitted, in conjunction with those already communicated to the Society, tend to show that there is no necessity for the assumption of any such purely mechanical causes underlying the hindrance to chemical reactions.

61. "The constitution and properties of acyl thiocyanates."

By John Hawthorne.

It has been shown (Dixon and Hawthorne, *Trans.*, 1905, **87**, 468) that when acetyl "thiocyanate" interacts with aniline, two changes occur simultaneously: (1) double decomposition, the sulphur appearing as thiocyanic acid, $AcSCN + PhNH_2 = HSCN + AcNHPh$; (2) addition, the sulphur now exhibiting thiocarbimidic functions, $AcNCS + PhNH_2 = AcNH{\cdot}CS{\cdot}NHPh$. At low temperatures the former reaction predominates, and at high temperatures the latter.

It has now been shown that, besides temperature, two other factors may have an influence on the course of the interaction between an acyl "thiocyanate" and a base: (1) the nature of the base presented, and (2) the nature of the acidic radicle of the "thiocyanate." The results are recorded of experiments made at various temperatures on the systems *o*-toluidine—acetyl "thiocyanate" and aniline—propionyl "thiocyanate," from which it appears (1) that *o*-toluidine causes a great increase of the thiocarbimidic functions of acetyl "thiocyanate" as compared with aniline, and (2) that, towards aniline, acetyl and propionyl "thiocyanates" behave very nearly alike.

Since in all the above reactions acetyl "thiocyanate" behaves towards a given base as if it were a mixture of acetyl thiocyanate and acetylthiocarbimide in proportions depending on the temperature, a series of determinations of the molecular refraction of the pure substance was carried out. Within the limits of temperature examined, this value was practically constant, the mean, 45·9, as deduced from the formula $M = \frac{(\mu - 1)m}{d}$, being inconsistent with the value required for a compound having the structure $Ac·S·C⋮N$, but agreeing closely with that corresponding to $Ac·N⁚C⁚S$.

62. "A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid." By Harold Rogerson and Jocelyn Field Thorpe.

By the condensation of the sodium derivative of ethyl cyanoacetate with ethyl oxalacetate, ethyl α-cyanoaconitate,

$$CN·CH(CO_2Et)·C(CO_2Et)⁚CH·CO_2Et,$$

is produced. This ethyl salt on hydrolysis with acid hydrolysing agents is converted into aconitic acid, whilst with alkaline hydrolytic agents it is transformed into citrazinic acid. Alkyl derivatives of these compounds are formed when alkyl derivatives of ethyl α-cyanoaconitate, prepared either by the direct alkylation of this substance or by the condensation of the sodium derivative of ethyl cyanoacetate with alkyl derivatives of ethyl oxalacetate, are hydrolysed. It was shown that aconitic acid, like glutaconic acid, has a symmetrical structure, and that α-methylaconitic and γ-methylaconitic acids are tautomeric.

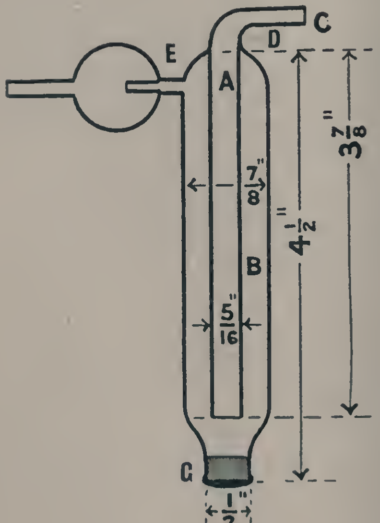
63. "Aromatic sulphonium bases." By Samuel Smiles and Robert Le Rossignol.

It was shown that the action of thionyl chloride on phenetole in presence of aluminium chloride gives rise to *p*-phenetylsulphoxide and triphenetylsulphonium chloride; the latter is produced by the action of excess of phenetole on the sulphoxide. This reaction has led to the discovery of two other methods of preparing these aromatic sulphonium bases: (1) from a sulphoxide and phenetole with a dehydrating agent; (2) from a sulphinic acid and phenetole with strong sulphuric acid. It is also shown that in this reaction a sulphoxide is formed as an intermediate product.

64. "A new form of calcium chloride tube for combustion." By Arthur Edwin Hill.

The calcium chloride tube indicated in section in the figure on p. 88 consists essentially of an inner exit tube, *A*, which is enclosed within a larger inlet tube, *B*, the latter being fused to the tube *A* at *D* and carrying a side-tube, *E*, provided with the usual form of bulb in which water can collect as liquid. The apparatus is easily filled by inverting it and pouring finely granulated calcium chloride into both the tubes *A* and *B*; before filling, a little glass wool should be inserted at the top of both the inner and outer tubes and after charging with calcium chloride more glass wool is introduced; a suitable cork is then inserted at *G*; finally, this cork is cut off flush with the bottom of the tube and neatly covered with sealing wax.

The bulk of the water produced in the combustion is condensed in the bulb on the tube *E*, the remainder being absorbed during the passage of the moist gases down *B* and up *A*. A double scrubbing action is thus obtained by the aid of a comparatively small weight of calcium chloride; this, in fact, in addition to its compactness, is a special feature of the tube and the cause of its efficiency. A certain amount of free space, not packed with the chloride, in the tube *B*, immediately above the point of connection with *E*, is allowed, into which the water vapour can diffuse before coming into contact with the calcium chloride; by this means, the calcium chloride is uniformly wetted.



The new form of tube presents a number of advantages:

(1) The double scrubbing action, which ensures complete desiccation by means of a comparatively small quantity of calcium chloride. The whole apparatus when filled weighs only from 25 to 30 grams.

(2) It can be very easily emptied and refilled. There are no tubes to be sealed off at the blow-pipe and only a single cork is required.

(3) It is very compact and strong, the bend which is a point of weakness in the ordinary **U**-tube being got rid of. It is also more easily manipulated than the ordinary form of tube.

(4) It can be more easily and rapidly wiped dry before weighing. Several analyses made for the purpose of testing the tube have shown that it gives perfectly satisfactory results. The carbon dioxide produced simultaneously with the water is easily and completely swept from the tube into the potash bulbs by the current of air usually employed in a combustion.

65. "The viscosity of liquid mixtures. Part III." By Albert Ernest Dunstan.

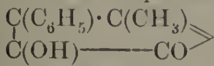
The author's previous work and his hypotheses regarding maximum and minimum points in viscosity.concentration curves were summarised and some relations between viscosity and molecular weight were indicated.

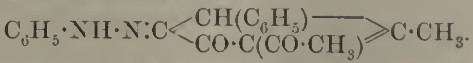
For liquid mixtures of unimolecular components, it was shown that the general viscosity curve is concave to the axis of percentage composition, owing to the reciprocal effect of each liquid on the other.

Moreover, the depression angles which measure these mutual effects are, in general, proportional to the molecular weight of the liquid concerned. The "external angle" lying between the curve and the viscosity axis is shown to be also proportional to the molecular weight of the liquid.

The formulæ proposed by Arrhenius was discussed, and it was pointed out that no formula can interpret the curves which does not contain a factor characteristic of each curve. Each allied substance lies on a simple parabolic curve. The curves connecting molecular weight with the $\log_{10}$ viscosities are straight lines. The associated lower members of each group diverge somewhat from this line. Water, and formic and acetic acids show anomalous behaviour. If the family to which any liquid belongs is known, the molecular weight of the liquid can be calculated.

66. "The action of phenylpropiolyl chloride on the ketonic compounds. Part II." By Siegfried Ruhemann.

The compounds previously described by Ruhemann and Merriman (*Trans.*, 1905, **87**, 1383) have been subjected to a closer investigation. The red compound $C_{14}H_{12}O_3$, which was represented by the formula  $\begin{array}{l}C(C_6H_5)\cdot C(CH_3)\\ C(OH)\text{———}CO\end{array}\!\!>C\cdot CO\cdot CH_3$, reacts with phenylhydrazine to yield a phenylhydrazone which, on account of its insolubility in alkali, is considered to have the constitution



$$C_6H_5\cdot NH\cdot N{:}C\!<\!\begin{array}{l}CH(C_6H_5)\text{———}\\ CO\cdot C(CO\cdot CH_3)\end{array}\!\!>C\cdot CH_3.$$

Its formation, therefore, is accompanied by the change of the enolic into the ketonic group. Analogous formulæ should be attributed to the semicarbazone, $C_{15}H_{15}O_3N_3$, and the oxime, $C_{14}H_{13}O_3N$. The fact that these two compounds are colourless indicates that the colour of the red compound $C_{14}H_{12}O_3$ is due to the grouping $-CO\cdot COH{:}C<$ and disappears with the change into $H\overset{|}{\underset{|}{C}}\cdot CO\cdot CO-$. The former configuration yields blue salts with alkalis. The results thus obtained are used to establish the structural formulæ of the derivatives of oxalyldibenzylketone (see Claisen and Ewan, *Annalen*, 1895, **284**, 245), the properties of which resemble the red substance $C_{14}H_{12}O_3$. The former compound with alkalis yields both blue salts and yellow salts. The blue salts owe their formation to the same arrangement of the ketonic and enolic groupings as is contained in the red substance $C_{14}H_{12}O_3$, whilst in the yellow salts the ketonic group occupies the β-position with respect to the enolic group.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Caven, *Robert Martin*, and **Lander**, *George Druce*. Systematic inorganic chemistry from the standpoint of the periodic law. pp. xix + 374. London 1906. (*Recd.* 2/3/06.) From the Authors.

Liebreich, *Oscar*. Third treatise on the effects of borax and boric acid on the human system. Being a critical review of the report of *Dr. H. W.* **Wiley**, Chief of the Bureau of Chemistry of the U.S. Department of Agriculture, to the Secretary of Agriculture. Translated from the German. With diagrams. pp. vii + 70. London 1906. (*Recd.* 9/3/06.) From the Publishers: Messrs. J. & A. Churchill.

Metropolitan Water Board. Report on the results of the chemical and bacteriological examinations of the London waters, for the month ending November 30th, 1905, &c. By *A. C.* **Houston**. London 1905. From the Board.

Rolfe, *George William*. The polariscope in the chemical laboratory. An introduction to polarimetry and related methods. pp. vii + 320. ill. New York 1905. (*Recd.* 9/3/06.) From the Publishers: The Macmillan Company.

Welch, *George Edward*. Chemistry lecture notes. pp. 63. London 1905. (*Recd.* 9/3/06.) From the Publishers: Messrs. Blackie & Son.

II. *By Purchase.*

Freund, *Ida*. The study of chemical composition. An account of its method and historical development. With illustrative quotations. pp. xvi + 650. ill. Cambridge 1904. (*Recd.* 3/3/06.)

Rutherford, *Ernest*. Radioactivity. pp. xiv + 580. Cambridge 1905. (*Recd.* 3/3/06.)

III. *Pamphlets.*

Day, *Arthur L.* Mineral solution and fusion under high temperatures and pressures. (From the *Year Book of the Carnegie Institution of Washington,* 4, 1905.)

Paterson, *David.* Concerning indigo, natural and artificial. (From the *Oil and Colourman's Journal,* 28, 1905.)

Schroeder, *August.* Beiträge zur Kenntnis einiger ausländischen Fette und Oele. pp. 67. Strassburg 1905.

Stapleton, *Henry Ernest.* Sal-ammoniac: a study in primitive chemistry. (From the *Memoirs, Asiatic Soc. Bengal,* 1, 1905.)

Stapleton, *Henry Ernest,* and **Azo,** *R. F.* Alchemical equipment in the eleventh century, A.D. (From the *Memoirs, Asiatic Soc. Bengal,* 1, 1905.)

Watts, *Francis,* and **Tempany,** *H.* The polarimetric determination of sucrose. (From the *West Indian Bulletin,* 6, 1905.)

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and Council and other business will be held on **Friday, 30th March, 1906, at 5 o'clock** in the afternoon.

The President will deliver his address entitled: "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

At the next Ordinary Meeting, on **Thursday,** April **5th,** 1906, at **8.30** p.m., the following papers will be read:

"An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light." By W. H. Perkin, sen.

"The rusting of iron." By G. T. Moody.

"The determination of carbon in soils." By A. D. Hall, N. H. J. Miller, and N. Marmer.

"The electrolysis of the salts of $\beta\beta$-dimethylglutaric acid." By J. Walker and J. K. Wood.

"Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid." By J. K. Wood.

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Issued 12/4/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 308.

Friday, 30th March, 1906. Annual General Meeting, Professor R. Meldola, F.R.S., President, in the Chair.

Prof. J. J. Sudborough and Mr. J. L. Baker were appointed Scrutators, and the Ballot was opened for the election of Officers and Council for the ensuing year.

The President presented the Report of the Council on the progress of the Society during the past twelve months. The adoption of the Report of the Council was proposed by Mr. R. J. Friswell, seconded by Dr. H. Brereton Baker, and carried unanimously.

REPORT OF THE COUNCIL.

The Council have the satisfaction of being able to report that the past year has been a prosperous one for the Society, the activity of which, as measured by the number of papers read and the number of Fellows on the list, has exceeded that of any previous year.

On the 31st December, 1904, the number of Fellows was 2,711. During 1905, 164 Fellows were elected and 2 reinstated, thus making a gross total of 2,877. The Society has lost 25 Fellows by death, 28 have resigned, the election of 3 has become void, 1 has withdrawn, and 35 have been removed for non-payment of Annual Subscriptions. The total number of Fellows, therefore, on the 31st December, 1905, was 2,785, showing an increase of 74 over the number for the previous year.

The names of the deceased Fellows, with the dates of their election, are:

W. Ackroyd (1897).
C. M. Blades (1885).
J. F. Braga (1881).
G. B. Buckton (1852).
J. L. Bullock (1842).
C. F. Burnard (1849).
J. H. Calvert (1871).
H. S. Carpenter (1875).
J. Duncan (1863).
H. S. Elworthy (1886).
J. Epps (1885).
E. Graham (1895).
W. H. Greenwood (1873).
F. W. Harrold (1891).
F. M. Mercer (1884).
M. Prasad (1903).
A. B. Prescott (1876).
W. T. Rickard (1845).
R. Roose (1886).
F. Shapley (1893).
C. W. Sutton (1884).
C. R. C. Tichborne (1863).
L. White (1862).
W. W. Will (1885).
R. Yates (1874).

The following Fellows have resigned:

J. Ball.
S. Barlet.
G. E. P. Broderick.
C. J. Brooks.
A. J. Carrier.
F. E. Catchpole.
C. Childs.
C. G. Cresswell.
J. Dennant.
H. Goodier.
H. P. Harris.
J. H. Hichens.
S. Hill.
A. Houston.
C. Hunt.
J. T. Johnson.
H. W. Kinnersley.
W. Lang.
H. W. Lawrence.
F. H. Lescher.
W. H. Martin.
J. Percival.
W. S. Rowntree.
T. Samuel.
C. E. S. Sherratt.
W. J. Stainer.
G. R. Tweedie.
T. E. Vasey.

The small number of Fellows still living who were elected in the early days of the Society has been further reduced by the death of Mr. G. B. Buckton, who was elected in March, 1852, and of Mr. J. L. Bullock, elected in 1842. Since the close of 1905, the Society has had to lament the loss of Professor Hermann Johann Philipp Sprengel, who was elected in December, 1864.

The number of Honorary and Foreign Members at the date of the last Annual General Meeting was 35. No names have been added to the list since then, but the Society has sustained a loss in the death of Professor P. T. Cleve, who was elected in February, 1883, and who died on June 18th, 1905. The work of the deceased Honorary and Foreign Member is to be commemorated by a Memorial Lecture, the delivery of which has been undertaken by Professor T. E. Thorpe.

During the year 1905, 233 scientific communications have been made to the Society, 191 of which have been published already in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of Transactions for 1905 contains 1,936 pages, of which 1,818 are occupied by 184 memoirs, the remaining 118 pages being devoted to the Wislicenus Memorial Lecture, the Obituary Notices, the Report of the Annual General Meeting, and the Presidential Address; the volume for the preceding year contains 175 memoirs, which occupy 1,715 pages.

The Journal for 1905 contains also 4,356 abstracts of papers published mainly in foreign journals, which extend to 1,828 pages, whilst the abstracts for 1904 numbered 4,617, and occupied 1,920 pages.

The abstracts for 1905 may be classified as follows:

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	956	1,727

Part II.

General and Physical Chemistry		619
Inorganic Chemistry.........................		562
Mineralogical Chemistry		71
Physiological Chemistry		467
Chemistry of Vegetable Physiology and Agriculture		295
Analytical Chemistry		615
	872	2,629
Total in Parts I. and II.	1,828	4,356

In making comparison with the preceding year, it must be borne in mind that the 1904 volume contained the abstracts for thirteen months. Owing to the change in date of publication, no abstracts appeared between December 1st, 1903, and January 31st, 1904, so that the number of the Journal published on the latter date contained practically the abstracts of two months (see *Trans.*, 1905, **87**, 539).

The Council regrets to announce that Dr. G. T. Morgan has found it necessary to resign the post of Editor of the Society's publications which he has occupied so creditably since the beginning of 1903. Although his resignation was received in September, 1905, Dr. Morgan kindly acted as Editor until the appointment of his successor, Dr. J. C. Cain.

The second part (Subject Index) of the Collective Index for the decade 1893–1902 was issued in December, 1905, to those Fellows who had made application for it in accordance with the printed notices circulated with the monthly parts of the Journal subsequently to July, 1903, and the Council have pleasure in expressing the high appreciation of the ceaseless energy displayed by the Indexer, Mrs. Margaret Dougal, on the completion of this valuable work.

During the vacation of 1905, advantage was taken of the Doctorial Jubilee of Professor Adolph von Baeyer, and of the Professorial Jubilee of Professor Mendeléeff, to address letters of congratulation to these two distinguished Honorary and Foreign Members.

In June, 1905, the Council decided that the Ordinary Meetings of the Society should be held during the ensuing Session on the first and third Thursdays of the month at 8.30 p.m. The experiment of holding the meetings on Wednesday afternoons at 5.30 p.m., alternately with Thursday evenings at 8 p.m., had been in operation since January, 1902, and from the fact that the average attendance of Fellows at the afternoon meetings had undergone steady diminution during this period, whilst the number of Fellows attending the evening meetings had increased, it has been concluded that a majority of the Fellows who make a practice of attending the meetings find the evening more convenient than the afternoon.

The Library has received an important addition by the generosity of Sir Henry E. Roscoe, who has presented to the Society a collection of 136 alchemical and early chemical works of great interest and value.

An increase in the use of the Library is recorded, 1,108 books being borrowed during 1905, as against 1,057 in the previous year. Additions to the Library, excluding Sir Henry Roscoe's donation, comprise 165 books, of which 58 were presented, 324 volumes of periodicals, and 48 pamphlets, as against 119 books, 296 volumes of periodicals, and 52 pamphlets last year. On the recommendation of the Library Committee the Council have made an addition to the Library Rules in the following terms: "No persons other than Fellows of the Society have the privilege of using the Library, except upon a written introduction from a Fellow, with whom rests the responsibility for all books consulted by the person introduced. Such introduction shall be valid for one occasion only."

Grants amounting in all to £236 have been made during the year from the Research Fund, and £22 15*s*. 3*d*. has been returned. Of the papers published in the *Transactions* during 1905, 24 were contributed by authors to whom grants had been made from the Research Fund.

In February of last year the Treasurer was fortunate enough to be able to increase the invested capital of the Society by almost exactly

£1,500 by the purchase of £1,983 Midland Railway 2½ per cent. Preference Stock for £1,499 14*s.* 5*d.* The income from all sources for the year 1905 exceeds that for 1904 by only £93 8*s.* 4*d.*, whilst the expenditure has been abnormally heavy, exceeding the total income by £305 1*s.* 5*d.* This is due to the incidence of several very heavy accounts, one of which really belongs to several years, and that is the completion of the Decennial Index for the period 1893–1902, which has entailed the expenditure this year of no less than £778 10*s.* 5*d.*, or rather more than half the total cost. No further expenditure, however, on account of Decennial Indexes will be required for several years to come. As pointed out last year, the continual increase in the cost of the *Journal* and *Proceedings* is a source of much anxiety, and this year a further increase has to be recorded on both accounts, £219 12*s.* 7*d.* in the former and £35 18*s.* 2*d.* in the latter case, or a net increase over the cost of both in 1904 of £255 10*s.* 9*d.*, and over that in 1903 of £578 3*s.* 3*d.* The Council therefore trust that authors of papers will do their utmost to assist the Publication Committee and the Treasurer in keeping down the cost of printing as far as possible.

The publication of the *Annual Reports on the Progress of Chemistry* has necessarily added materially to the expenditure of the Society; the cost of Volume I having entailed an expenditure of £445 19*s.* 6*d.*, of which about £70 has been recovered by their sale. Another item of some magnitude, £52 9*s.* 6*d.*, is the cost of the printing and circulating of the Bye-laws, together with the changes proposed by the Council, which were submitted to an Extraordinary General Meeting of the Society on February 8th, 1905.

The administrative expenses have been carefully kept in check, and whilst everything has been maintained in a state of thorough efficiency their amount is only £827 16*s.* 5*d.*, as against £893 1*s.* 0*d.* in 1904.

The following facts with regard to the cost of the Decennial Indexes may be of interest. The total cost of Volume IV, 1893–1902 (Parts I and II), exclusive of distribution amounts to £1,454 5*s.* 6*d.*, of which the cost of printing was £762 6*s.* 0*d.* The cost of Volume III, 1883–1892 (issued in one volume) was £1,280 2*s.* 7*d.*, of which the printing accounted for £585 19*s.* 7*d.* The cost of Volume IV was relatively considerably less than that of Volume III, as the former extended to 45½ sheets for the Authors' Index and 108 sheets for the Subject Index, or 153½ sheets in all, whilst Volume III only contained 102¾ sheets. Owing to the way in which the Annual Indexes are now prepared, it is hoped that when Volume V has to be undertaken, the relative cost will be still further reduced and that the chief cost will be that due to the printing.

The Treasurer gave a statement as to the Society's income and expenditure during the year 1905, and proposed a vote of thanks to the Auditors, which was seconded by Dr. BERNARD DYER and carried unanimously, acknowledgment being made by Dr. H. FORSTER MORLEY.

A vote of thanks to the Treasurer, Secretaries, Foreign Secretary, and Council for their services during the past year was proposed by Dr. T. E. THORPE, seconded by Sir THOMAS STEVENSON, and unanimously adopted. Sir WILLIAM RAMSAY responded.

The PRESIDENT then delivered his Address, entitled "The living organism as a chemical agency: A review of some of the problems of photosynthesis by growing plants."

Sir HENRY E. ROSCOE proposed a vote of thanks to the President, coupled with the request that he would allow his Address to be printed in the Society's *Transactions.* Dr. HORACE BROWN seconded the motion, which was carried by acclamation, and acknowledged by the President.*

The Scrutators then presented their Report to the President, who declared the following to have been duly elected as Officers and Council for the ensuing year :—

President : Raphael Meldola, F.R.S.

Vice-Presidents who have filled the office of President : H. E. Armstrong, Ph.D., LL.D., F.R.S. ; A. Crum Brown, D.Sc., LL.D., F.R.S. ; Sir William Crookes, D.Sc., F.R.S. ; Sir James Dewar, M.A., LL.D., F.R.S. ; A. Vernon Harcourt, M.A., D.C.L., F.R.S. ; H. Müller, Ph.D., LL.D., F.R.S. ; W. Odling, M.A., M.B., F.R.S. ; W. H. Perkin, Ph.D., LL.D., F.R.S. ; J. Emerson Reynolds, Sc.D., M.D., F.R.S. ; Sir Henry E. Roscoe, LL.D., F.R.S. ; W. J. Russell, Ph.D., F.R.S. ; T. E. Thorpe, C.B., LL.D., F.R.S. ; W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents : Horace T. Brown, LL.D., F.R.S. ; Harold B. Dixon, M.A., F.R.S. ; Rudolph Messel, Ph.D. ; W. H. Perkin, jun., Ph.D., F.R.S. ; A. Smithells, B.Sc., F.R.S. ; W. P. Wynne, D.Sc., F.R.S.

Treasurer : Alexander Scott, M.A., D.Sc., F.R.S.

Secretaries : M. O. Forster, D.Sc., Ph.D., F.R.S. ; A. W. Crossley, D.Sc., Ph.D.

Foreign Secretary : Sir William Ramsay, K.C.B., LL.D., F.R.S.

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* The Address will appear in the April number of the Journal.

Ordinary Members of Council: Edward C. C. Baly; Bernard Dyer, D.Sc.; William Gowland; Alfred D. Hall, M.A.; H. A. D. Jowett, D.Sc.; A. Lapworth, D.Sc.; J. E. Marsh, M.A.; F. E. Matthews, Ph.D.; G. T. Moody, D.Sc.; A. G. Perkin, F.R.S.; W. J. Sell, M.A., F.R.S.; John Wade, D.Sc.

Thursday, April 5th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT announced the donation by Mr. John Spiller of a Berzelius medal in selenium, which had been in the possession of the donor during the past fifty years.

It was also stated that the Council had appointed the following Committees:

Finance Committee.—E. G. Hooper, G. T. Moody, H. T. Brown, T. E. Thorpe, W. A. Tilden, and the Officers.

House Committee.—W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. M. Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

Library Committee.—E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. Millar Thomson (*Chairman*), J. A. Voelcker, J. Wade, the Editor, and the Officers.

Publication Committee.—H. E. Armstrong, E. C. C. Baly, B. Dyer, E. J. Mills, W. A. Tilden, J. Wade, and the Officers.

Research Fund Committee.—H. T. Brown, W. R. Dunstan, P. F. Frankland, A. D. Hall, G. Matthey, R. Messel, H. Müller, W. H. Perkin, jun., S. P. U. Pickering, W. A. Tilden, and the Officers.

Messrs. T. V. Barker and I. B. Hobsbaum were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

Percy Corlett Austin, M.A., Queen's College, Galway.
Lionel John Drinkwater, 27, Stokenchurch Street, Fulham, S.W.
Bernhard Flurscheim, Ph.D., Heatherlands, Fleet, Hants.
Edgar Percy Hedley, 6, Royal Terrace West, Kingstown, Co. Dublin.
Arthur Edwin Hill, 236, Willesden Lane, Brondesbury, N.W.
Frederick Gowland Hopkins, M.A., M.B., D.Sc., F.R.S., Stafford House, Newnham, Cambridge.
Thomas Macdonald, North Frodingham, Driffield, Yorkshire.

Harold Lawson Pendlebury, 4, Wentworth Street, Bolton.
Percy George Pennymore, Eskbank Iron and Steel Works, Lithgow, N.S.W.
Walter Hansen Rawles, 81, Lewisham High Road, S.E.
John Senior, Sizing Hill, Batley Carr, Dewsbury.
Emanuel George Stirimer, Park House, Margery Park Road, Forest Gate, E.
Richard Lumley Treble, B.Sc., The School Lodge, Cranbrook, Kent.
Robert Hutchison Turnbull, Messrs. MacAndrews & Forbes Co., Smyrna, Turkey-in-Asia.
Charles Wightman, 43, Portland Place, W.

Of the following papers, those marked * were read :

*67. "An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light." By William Henry Perkin, sen.

The author dealt with the advantages and disadvantages of the ordinary electro-magnet with pierced pole-pieces and also the long coil or helix as a means of obtaining a magnetic field suitable for the measurement of magnetic rotations, and the desirability of obtaining an apparatus which shall possess all the advantages without the disadvantages of either of these systems. This has been effected by using a short but very powerful coil and a powerful electric current. The coil is cased with steel and has a three-inch gun-metal tube through the centre, the interior of this being the position of the magnetic field. The glass measuring tubes are supported in this tube in a metal trough which can be kept at any required temperature. Reference was also made to the measurement of the plane of polarisation and the difficulties which arise from the fact that the sodium flame is not purely monochromatic. This defect was especially felt when measuring large rotations and was successfully overcome by the use of a direct vision prism attached to the eye-piece or placed in the telescope of the analyser ; through this a distinct image of the half-shadow disc is observed ; this disc is on the analyser in the apparatus used : the prismatic colours arising from the impurity of the sodium flame are seen on either side of the image. Lastly, a method of obtaining a powerful sodium light was described, which consists in employing a large Bunsen burner with a fine tube up the centre which is supplied with oxygen. This burner, placed under a platinum boat containing sodium chloride, is heated by the ordinary flame, which keeps the sodium chloride in a state of semi-fusion, whilst the internal flame, produced by the oxygen passing up the small tube, impinges on the side, and at the same time somewhat under the boat; this causes the sodium chloride to volatilise, and at the same time the part of the flame passing up the side receives the sodium chloride vapour and gives a very intense, yellow light, which can be maintained for a long time.

DISCUSSION.

After referring to the fact that Dr. Perkin had this year been fifty years a Fellow of the Society, Professor ARMSTRONG expressed the opinion that probably in days to come, when physicists understood sufficient chemistry to appreciate Dr. Perkin's work on magnetic rotation, it would be regarded as of greater importance even than his discovery of the coal-tar colours.

The PRESIDENT, in moving a vote of thanks to Dr. Perkin, congratulated him on having brought to its present state of perfection the beautiful method of exploring chemical constitution by an optical method which he had conceived twenty-five years ago, and which he had practically made his own. The apparatus described was unfortunately not an ordinary laboratory installation, and he was therefore afraid that Dr. Perkin was likely to bring more work upon himself, since the discoverers of new compounds would more and more have to depend on him for the determination of magnetic rotations when, as was certain to be the case, the value of the method became more widely recognised. The President reminded the meeting how largely the pages of the Transactions already bore testimony to the value of the method and to the courtesy of the author in placing his services at the disposal of investigators.

*68. "The rusting of iron." By Gerald Tattersall Moody.

Contrary to the statement of Dunstan, Jowett, and Goulding (*Trans.*, 1905, **87**, 1548), it is found that when bright iron is left in contact with air and water, both of which have been completely freed from carbonic acid, the metal remains untarnished, whatever the duration of the exposure. No absorption of atmospheric oxygen by iron takes place in presence of water, provided that carbonic acid has been first removed from both air and water, but on admission of a small quantity of the gas, rapid oxidation of the metal and diminution in volume of the oxygen are observed.

It is found, moreover, that the composition of iron rust is not fairly represented by the formula $Fe_2O_2(OH)_2$, as stated by the foregoing investigators. An examination of a number of recently formed specimens shows that a large proportion of the iron is invariably present in the ferrous state, partly as oxide and partly as carbonate.

The explanation of rusting as a process involving the production of hydrogen peroxide, as advanced by Dunstan, is directly negatived by experimental evidence, which shows that atmospheric corrosion results first from the interaction of iron and carbonic acid, whereby ferrous salt is formed, and subsequently from the more or less complete oxidation of ferrous salt by oxygen.

DISCUSSION.

Prof. ARMSTRONG said that, having seen the work, he was able to testify to the extreme care and patience which Dr. Moody had devoted to the inquiry; the experiments had been made without bias, solely with the object of ascertaining whether iron were oxidisable by water and oxygen alone. The result was beyond question. It was not creditable to chemists, however, that problems of such fundamental importance should have so long been neglected in favour of work of no particular value to anyone, and that it should still be possible to dispute on such questions. Notwithstanding all the talk about ions, we were still without any clear accepted doctrine as to the conditions which determined the attack of oxygen on metals. Personally he had never been in doubt since he had realised that all such actions were essentially electrolytic—he had therefore felt unable to believe in the possibility of the interaction of iron, oxygen, and water taking place in the absence of an electrolyte—water not being an electrolyte. He had also never been able to accept the peroxide explanation; even supposing that rusting were inhibited by all substances which decomposed the peroxide, there was no reason to suppose that the destruction of the peroxide could in any way prevent the oxidation of the metal; some other explanation must be sought for the stoppage of action.

Mr. A. R. LING recounted his experiences with an acid water, derived from the red sandstone of Somersetshire, which vigorously attacked iron, producing rust. This action was prevented by adding to the water 7 grains per gallon of lime, but an equivalent amount of sodium carbonate was without effect. Caustic alkalis in equivalent amount prevented rusting only so long as the water was kept out of contact with the atmosphere. Rusting occurred also in presence of alkali sulphites.

Dr. GOULDING pointed out that the hydrogen peroxide solutions employed in Dunstan, Jowett, and Goulding's experiments did not contain free mineral acid, as Dr. Moody had stated, but were purified in all cases. The method usually adopted was to shake the solution thoroughly with barium carbonate, and afterwards to boil it under reduced pressure in order to eliminate carbon dioxide.

Mr. W. A. DAVIS referred to the opinion expressed by Prof.

Dunstan and his colleagues in their paper, that Dr. Moody had "misread" the account given by Giorgis (*Gazzetta*, 1891, **21**, 510) of the action of hydrogen peroxide on magnesium. The tenor of this paper is to show that hydrogen peroxide when freed as far as possible from carbon dioxide attacks magnesium very much less readily than ordinary hydrogen peroxide containing carbon dioxide. Dr. Moody's statement that "hydrogen peroxide when carefully freed from carbon dioxide is *practically without action* on magnesium," is but a paraphrase of Giorgis' own conclusion that pure magnesium "è ossidato *in minima quantità* dall' acqua ossigenata neutra." Giorgis' hydrogen peroxide was not strictly neutral, but very slightly acid (*appena acida*), a fact which perhaps accounts for there being any action at all.

Dr. H. Borns said that Dr. Moody had certainly taken great pains to settle the problem definitively, but he should, however, have prevented the possibility of access of ozone, nitrogen compounds, sulphurous acid, &c., when finally admitting the air.

Dr. Moody, in reply, said that the method of purifying hydrogen peroxide, as detailed by Dr. Goulding, was obviously inadequate, since in removing one impurity others were introduced. He doubted if acid could be completely removed by such a process without decomposing the whole of the hydrogen peroxide in the solution. With regard to Dr. Borns' remark, the arrangements for scrubbing the air were such that all acid constituents likely to attack iron were eliminated.

*69. "The estimation of carbon in soils." By Alfred Daniel Hall, Norman Harry John Miller, and Numa Marmu.

Wet combustion with chromic acid has been frequently used for the estimation of carbon in soils, but, as Warington has pointed out, it always gives results too low by 10—20 per cent. This is due to the oxidation of the carbon compounds not proceeding so far as carbon dioxide, and is shown by the authors to be obviated by the introduction of a short length of red-hot copper oxide between the reacting flask and the alkali used for absorbing the carbon dioxide. The authors employ a Reiset tower for absorbing the carbon dioxide, which is then estimated by double titration, as suggested by Brown and Escombe.

Discussion.

Dr. Voelcker thought the process described would be a good one, and it had the advantage that both the carbonic acid and the organic carbon could be estimated in the one portion of soil. It would be interesting to know whether the authors had made a comparative test by Pettit and Schaub's method (*J. Amer. Chem. Soc.*, 1904, **26**, 1640), which consisted in combustion with sodium peroxide.

70. "Electrolysis of salts of ββ′-dimethylglutaric acid." By James Walker and John Kerfoot Wood.

Sodium ethyl ββ′-dimethylglutarate, when electrolysed in concentrated aqueous solution, yields as chief product the diethyl ester of ββ′β′β′-tetramethylsuberic acid. This ester, the corresponding acid, and some of its salts are described.

Sodium ββ′-dimethylglutarate under like conditions yields at the anode chiefly carbon monoxide and carbon dioxide. There is formed simultaneously, however, a small quantity of a pentene, C_5H_{10}, which was proved to be unsymmetrical methylethylethylene. The formation of this compound can only be explained on the assumption of the migration of a methyl group. This affords an analogue to the production of ethyl *iso*lauronolate on the electrolysis of sodium orthoethylcamphorate.

71. "Bromo- and hydroxy-derivatives of ββ′β′β′-tetramethylsuberic acid." By John Kerfoot Wood.

Perkin and Thorpe (*Trans.*, 1899, **75**, 48) found that the bromoesters of ββ-dimethylglutaric acid, when heated with alcoholic potash, lose hydrogen bromide and are converted into the caronic acids. The author has investigated the action of alcoholic potash on the bromoderivatives of ββ′β′β′-tetramethylsuberic acid, the ester of which is the direct synthetical product obtained during the electrolysis of sodium ethyl ββ-dimethylglutarate. The action in this case is of a different nature from that investigated by Perkin and Thorpe; no cyclic compounds were formed, the only products isolated being hydroxy-derivatives of ββ′β′β′-tetramethylsuberic acid.

72. "Some new *o*-xylene derivatives." By George Stallard.

A new bromo-*o*-xylene ($CH_3 : CH_3 : Br = 1 : 2 : 3$) is obtained by hydrolysis of a bromosulphonic acid obtained by Kelbe by brominating *o*-xylene-4-sulphonic acid.

On sulphonation, it gives a mixture of two acids, one of which, the major product, has its substituents in the following positions: $CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 3 : 6$, as on debromination the *o*-xylene-3-sulphonic acid is obtained from it. The substituents of the other acid are present in the positions: $CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 3 : 4$ or $1 : 2 : 3 : 5$, as the compound is identical with Kelbe's acid mentioned above, and isomeric with the acid

$$CH_3 : CH_3 : Br : SO_3H = 1 : 2 : 4 : 5,$$

obtained by Jacobsen by sulphonating 4-bromo-*o*-xylene.

73. "A new solvent for gold. Preliminary note." By James Moir.

The author finds that gold-leaf dissolves fairly readily when floated on an acid solution of ordinary thiocarbamide. The action is rapid when a suitable oxidising agent is added: for example, when a solution of thiocarbimide is acidified and treated with a little ferric chloride, potassium dichromate, or hydrogen peroxide, the mixture dissolves gold-leaf after less than a minute's shaking. The solution is not precipitated either by ferrous sulphate or by stannous chloride (except after long standing), whence it follows that the gold is present in solution as part of a complex ion. The gold compound has been isolated in brilliant, colourless, six-sided lozenges, striated parallel to the longest axis, and is identical with a compound which the author has obtained by boiling a mixture of sodium aurichloride and thiocarbamide solutions. It is apparently different from the compound $AuCl,2CH_4N_2S$, described by Emerson Reynolds and by B. Rathke as being obtained in the reaction between aurichloride and thiocarbamide, since the mean of four concordant analyses gave $Au = 45{\cdot}42$, whereas $AuCl,2CH_4N_2S$ requires 51·24 per cent. Both Reynolds and Rathke give the theoretical value for gold in this compound as about 51·05, owing to the use of an incorrect value for the atomic weight of gold.

74. "The molecular condition in solution of ferrous oxalate. A correction." By Samuel Edward Sheppard and Charles Edward Kenneth Mees.

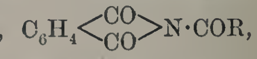
In a paper on this subject (*Trans.*, 1905, 87, 189), the authors found for the dissociation-constant $\frac{[Fe(C_2O_4)_2'']}{[C_2O_4'']}$ the value 0·81 at 20°. Abegg and Schäfer working at 25° find the value 0·37, a discrepancy too considerable to be due to the temperature difference. Professor Abegg, who has very kindly brought this circumstance to the authors' notice, has also pointed out the cause of this discrepancy. This was due to an error in the authors' calculation, whereby in calculating the concentration of $Fe(C_2O_4)_2''$ the permanganate titre for C_2O_4'' was added. The correct calculation is as follows. The increase in the permanganate titre being 68·4 c.c., of this two-thirds are equal to 45·7 molecules of FeC_2O_4 dissolved. These 45·7 mols. of FeC_2O_4, taking 45·7 mols. of C_2O_4'' from the 197·8 mols. of C_2O_4'' originally present, form 45·7 mols. of $Fe(C_2O_4)_2''$ and leave $197{\cdot}8 - 45{\cdot}7 = 152{\cdot}1$ mols. C_2O_4'', so that $K = \frac{45{\cdot}7}{152{\cdot}1} = 0{\cdot}30$.

From the accepted results with longer time of stirring, the recalculated value for K is 0·39 at 20°, in good agreement with Abegg and Schäfer's value 0·37 at 25° (*Zeit. anorg. Chem.*, 1905, **45**, 317).

75. "Acetyl and benzoyl derivatives of phthalimide and phthalamic acid." By Arthur Walsh Titherley and William Longton Hicks.

Phthalic anhydride, like succinic anhydride (*Trans.*, 1904, **85**, 1679), interacts with sodium benzamide, as well as sodium acetamide, yielding the corresponding acylphthalamic acids,

$$CO_2H{\cdot}C_6H_4{\cdot}CO{\cdot}NH{\cdot}COR.$$

The latter readily undergo internal condensation on treatment with acetyl chloride, giving the acylphthalimides,  $C_6H_4{<}\substack{CO\\CO}{>}N{\cdot}COR$, identical with products obtained by the acylation of phthalimide, namely, benzoylphthalimide by pyridine benzoylation and acetylphthalimide, which has already been described by Aschan (*Ber.*, 1886, **19**, 1400), by heating phthalimide with acetic anhydride.

Both acylphthalimides decompose on cautiously warming with aqueous sodium carbonate, the imide ring undergoing hydrolytic rupture with formation of the corresponding acylphthalamic acid, $CO_2H{\cdot}C_6H_4{\cdot}CO{\cdot}NH{\cdot}COR$. Aschan, on the other hand, stated that acetylphthalimide was hydrolysed with alkalis, giving phthalimide and acetic acid. The authors cannot confirm this observation, but show that when hydrolysis occurs it is preceded by rupture of the cyclic imido-grouping. Similar observations have been made by one of the authors (*Trans.*, 1904, **85**, 1686) in the case of benzoylsuccinimide, which on hydrolysis first yields benzoylsuccinamic acid, and finally succinic and benzoic acids and ammonia.

76. "The dynamic isomerism of phloroglucinol."
By Edgar Percy Hedley.

It is well known that alkalis and acids affect the equilibrium existing between two isomerides in solution, and that the action of the alkali is to increase the oscillatory change in one direction, whilst the acid, on the other hand, decreases it.

If phloroglucinol exists in solution in two forms—the enolic and ketonic modifications—then the position and persistency of the absorption band ought to undergo modification in the presence of alkali, and ought, in fact, to be displaced towards the less refrangible end of the spectrum. On the other hand, in the presence of acid, the persistency of the band ought to be decreased and become more like that of phloroglucinol trimethyl ether. These arguments were fully borne out by experimental test.

Lowry has pointed out that in some cases the solvent affects the equilibrium between dynamic isomerides. It was therefore thought advisable to examine whether in the case of phloroglucinol the solvent had any effect. Any non-ionising solvent would be suitable, provided it transmitted the ultra-violet light to a sufficient extent. Accordingly ether, a good and diactinic solvent, was used, and was found to have no effect on the spectrum.

The following conclusions were established: (1) that in neutral solutions phloroglucinol exists in both modifications, the enol being greatly in preponderance over the keto-form, and (2) that this equilibrium is undisturbed by the class of solvent.

77. "Studies in asymmetric synthesis. V. Asymmetric syntheses from *l*-bornyl pyruvate." By Alexander McKenzie and Henry Wren.

The authors have examined the reduction of *l*-bornyl pyruvate by aluminium amalgam, and find that an asymmetric synthesis of *l*-lactic acid may be accomplished in accordance with the scheme:

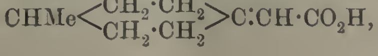
$$CH_3{\cdot}CO{\cdot}CO_2H\ \text{(inactive)} \longrightarrow CH_3{\cdot}CO{\cdot}CO_2{\cdot}C_{10}H_{17}^{*}\ \text{(active)}$$
$$\longrightarrow CH_3{\cdot}\overset{*}{C}H(OH){\cdot}CO_2{\cdot}C_{10}H_{17}^{*}\ \text{(active)}$$
$$\longrightarrow CH_3{\cdot}\overset{*}{C}H(OH){\cdot}CO_2H\ \text{(active)}.$$

The actions of magnesium ethyl iodide, magnesium *iso*butyl iodide, magnesium phenyl bromide, and magnesium α-naphthyl bromide respectively on *l*-bornyl pyruvate, and of magnesium *iso*butyl iodide and magnesium α-naphthyl bromide respectively on *l*-menthyl pyruvate, have been studied. The results obtained are contrasted with those recorded in a previous paper with the object of comparing the effect, first, of the active menthyl and bornyl groups, and, secondly, of the various alkyl (or aryl) halides used on the extent of the asymmetric syntheses of the resulting substituted glycollic acids.

78. "1-Methyl*cyclo*hexylidene-(4)-acetic acid."

By William Henry Perkin, jun., and William Jackson Pope.

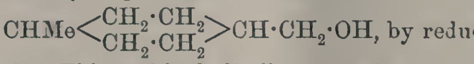
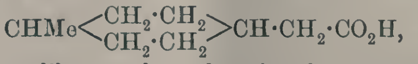
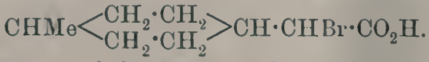
The current number of the *Berichte* (1906, 39, 1171) contains a paper by W. Markwald and R. Meth, in which these investigators describe the synthesis of an acid to which they assign the formula

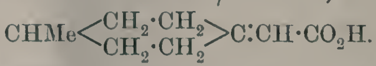


$$CHMe{<}{\begin{matrix}CH_2{\cdot}CH_2\\CH_2{\cdot}CH_2\end{matrix}}{>}C{:}CH{\cdot}CO_2H,$$

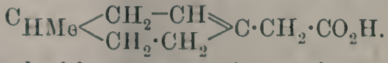
and which they have resolved into active modifications by fractional crystallisation of the cinchonine salts.

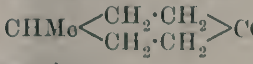
During the last three years, the authors have been engaged in an attempt to prepare a substance which, while not containing an asymmetric carbon atom, is yet capable of existing in optically active modifications, and it is noteworthy that one of the substances selected for examination was methyl*cyclo*hexylideneacetic acid. Since, however, the method of preparation is quite different from that of Markwald and Meth, and the results obtained are not in agreement with theirs, the following preliminary account of the authors' experiments is now put forward.

Ethyl hexahydro-*p*-toluate is converted into *hexahydro*-p-*tolylcarbinol*,  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}{>}\mathrm{CH\cdot CH_2\cdot OH}$, by reduction with sodium and alcohol. This carbinol distils at 197° and is readily converted into *hexahydro*-p-*tolyl bromide* (b. p. 135°/150 mm.) by the action of hydrobromic acid at 120°. When this bromide is heated with potassium cyanide and the product hydrolysed, it yields *hexahydro*-p-*tolylacetic acid*,  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}{>}\mathrm{CH\cdot CH_2\cdot CO_2H}$, which melts at 73—74° and is readily acted on by phosphorus pentachloride and bromine with formation of *α-bromohexahydro*-p-*tolylacetic acid* (m. p. 78°),  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}{>}\mathrm{CH\cdot CHBr\cdot CO_2H}$.

The ester of this bromo-acid is decomposed by boiling with diethylaniline with elimination of hydrogen bromide and formation of *ethyl methyl*cyclo*hexylideneacetate*, which distils at 158°/100 mm., and, on hydrolysis, yields the free acid,  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}{>}\mathrm{C{:}CH\cdot CO_2H}$.

The methyl*cyclo*hexylideneacetic acid thus obtained crystallises from formic acid in glistening plates and melts at 70—71°, whereas the acid described by Markwald and Meth, and to which these authors assign this constitution, melts sharply at 40—41°.

The method of preparation seems to leave no doubt that the acid melting at 70—71° is methyl*cyclo*hexylideneacetic acid, whilst the acid of melting point 40—41° described by Markwald and Meth is possibly the isomeric acid,  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2{-}CH}\\ \mathrm{CH_2\cdot CH_2}}{\geqslant}\mathrm{C\cdot CH_2\cdot CO_2H}$.

The fact that, when heated with strong caustic potash, it is decomposed into 4-methyl*cyclo*hexanone,  $\mathrm{CHMe}{<}\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}{>}\mathrm{CO}$, and acetic acid is easily explained on this assumption.

It is well known that an unsaturated acid which contains the double linking in the *βγ*-position is readily converted, by the action of strong caustic potash, into the corresponding *αβ*-unsaturated acid, and this isomeric change may have taken place in the case of Markwald and Meth's acid prior to the decomposition into methyl*cyclo*hexanone and acetic acid.

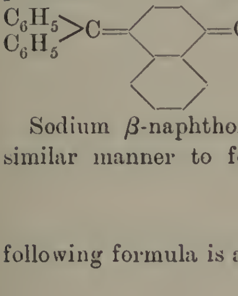
The authors are investigating this matter further, and are also engaged in a series of experiments with the object of resolving the acid melting at 70—71° into optically active modifications.

79. "Condensation of benzophenone chloride with α- and β-naphthols." By George William Clough.

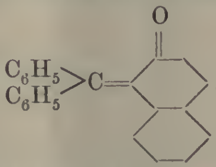
By heating α-naphthol with benzophenone chloride, the author has prepared di-α-hydroxynaphthyldiphenylmethane, the acetyl and benzoyl derivatives of which have also been obtained.

When benzophenone chloride was added to a boiling solution of β-naphthol in xylene, the product obtained was di-β-naphthoxydiphenylmethane, which is hydrolysed by dilute sulphuric acid into β-naphthol and benzophenone.

The action of sodium α-naphthoxide on benzophenone chloride resulted in the formation of the inner anhydride of α-naphthyldiphenylcarbinol, and the same substance was also obtained by adding α-naphthol to a boiling solution of the ketone chloride in light petroleum. This compound is yellow and the quinonoid formula, has been assigned to it.



Sodium β-naphthoxide interacts with benzophenone chloride in a similar manner to form a red, crystalline substance, to which the following formula is ascribed :

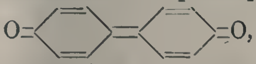


These coloured compounds are soluble in concentrated sulphuric, nitric, and hydrochloric acids respectively, the α-compound giving violet and the β-compound green solutions in these acids.

A condensation of benzophenone itself with α-naphthol has also been effected by heating these substances in the presence of zinc chloride and hydrogen chloride at 150—160°. The product obtained was α-oxydinaphthyldiphenylmethane, $C(C_6H_5)_2<\begin{smallmatrix}C_{10}H_6\\C_{10}H_6\end{smallmatrix}>O$, the condensation resembling that of acetone with α-naphthol (Dianin, Abstr., 1893, i, 214). Its solution in concentrated sulphuric acid is yellow and exhibits a green fluorescence.

80. "The constitution of cœrulignone (cedriret). A preliminary note." By James Moir.

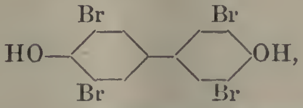
On the authority of Liebermann, Hofmann, and others, it has been accepted that cœrulignone is tetramethoxyldiphenoquinone: in addition, several strictly analogous substances have been prepared and formulated by their discoverers as the corresponding tetra-chloro-, -bromo-, -amino-, and -hydroxy-derivatives of diphenoquinone.

Now diphenoquinone itself, , has recently been prepared by Willstätter and Kalb (*Ber.*, 1905, **38**, 1232), and the author finds that its properties are quite different from those of cedriret and its analogues, and that, in fact, diphenoquinone is a true para-quinone, whereas cedriret and its analogues do not possess any quinonoid property except colour. Their properties are: (1) complete insolubility in organic solvents; (2) metalloid lustre; (3) decomposition on heating without melting or subliming; (4) intense colorations—blue to crimson—with sulphuric acid; (5) characteristic colour reactions with alkali; (6) production of complex sulphonates of high molecular weight through the action of sodium sulphite. Such properties as these indicate molecular complexity and a polyquinonoid constitution.

The author finds that the "diphenoquinhydrone" of Willstätter and Kalb (*loc. cit.*) is the true parent substance of cedriret, since it possesses all the foregoing properties. Nevertheless, it is doubtful at present whether this substance is really a simple quinhydrone, that is, a direct additive product of diphenoquinone and diphenol; some of its reactions indicate a larger molecular weight and higher percentage of oxygen than the formula $C_{24}H_{18}O_4$ requires.

The substance described by Magatti as tetrabromodiphenoquinone (*Ber.*, 1881, **13**, 226) has been studied more in detail. In the first place, it is quite different from the true tetrabromodiphenoquinone, which the author has prepared by oxidising tetrabromodiphenol with lead peroxide, and which forms transparent, orange crystals, is soluble in many organic solvents, and otherwise resembles diphenoquinone. Magatti's substance contains a lower percentage of bromine than is required by such a formula as $C_{12}H_4O_2Br_4$, and Magatti's analysis in support of this formula may be set aside as probably fictitious, since he has miscalculated the theoretical proportion of bromine and yet his analysis agrees with the assumed theoretical value. The compound gives, even in traces, a magnificent crimson shade with sulphuric acid, and on digestion with alkali forms a derivative which closely resembles indigotine in colour and coppery lustre; this can be also prepared directly by careful oxidation of an alkaline solution of tetrabromodiphenol with iodine or potassium ferricyanide.

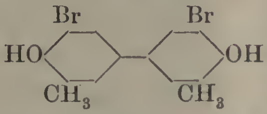
The orientation of the bromine atoms in tetrabromodiphenol has been settled to be as in the formula



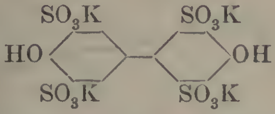
(3 : 5 : 3′ : 5′-tetrabromo-4 : 4′-diphenol).

since the sole product of the oxidation of its diacetate was 3 : 5-dibromo-4-acetonylbenzoic acid.

Finally, two new analogues of cedriret have been prepared by oxidising the compounds



and



respectively; the former has a green, graphite-like lustre and gives a maroon shade with sulphuric acid, whilst the latter, easily soluble in water, has a very dark indigo colour.

81. "A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radicle." By Thomas Vipond Barker.

The perchlorates of potassium, rubidium, cæsium, and ammonium form an isomorphous group similar to that of the permanganates of the same metals, which were investigated by Muthmann. The salts are orthorhombic and possess perfect cleavages parallel to the basal plane and the prism. All the constants of rubidium perchlorate determined are intermediate between those of potassium and cæsium perchlorates; ammonium perchlorate, again, lies very close to rubidium perchlorate, as does also thallium perchlorate according to Roscoe's measurements. The series, therefore, resembles the isomorphous groups investigated by Tutton. On comparing the perchlorates with the permanganates, it is found that the effect of replacing an atom of chlorine by one of manganese is much the same as that induced by the substitution of sulphur by selenium, say, in the sulphates of the same metals. The crystallographic evidence for placing manganese in the seventh group of the periodic classification, so far as such evidence goes, is therefore of the strongest possible kind.

Five crops of isomorphous mixtures of potassium perchlorate and permanganate of varying composition were measured. In one crop only, corresponding very closely to the formula $K_2(ClO_4)(MnO_4)$, were abnormal angles found, that is, angles the values of which lie outside those of the constituent salts; moreover, these angles were all in one zone, in which the faces were possibly vicinal.

82. "Contributions to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another." By Thomas Vipond Barker.

The parallel growths of sodium nitrate on cleavage surfaces of calcite are independent of the locality or variety of the calcite so long as a good, fresh cleavage surface is obtainable. Regular growths of rhombohedra of the nitrate were also obtained upon certain other forms of calcite, for example, the prism, scalenohedron, a steep rhombohedron, and the rare prism $\{\bar{1}10\}$; in all cases a pair of similar edges of the calcite and sodium nitrate are congruent. The effect of a magnetic field on the orientation of the crystals was purely negative. No parallel or regular growths could be obtained on the other minerals of the calcite group—dolomite, calamine, chalybite, rhodocrosite, diallogite, and breunnerite—nor on barytocalcite. The failure of the latter minerals to induce a parallel deposition is probably not due to a difference of symmetry or of angle (or axial ratio), but to a dissimilarity of molecular volume, and hence of topic axes also.

This view is strengthened by the discovery of parallel growths among the members of another and more numerous series of isostructural minerals and salts: potassium perchlorate and permanganate are deposited (from aqueous solution) upon barytes, celestine, and anglesite in parallel position, whereas the perchlorates of rubidium, cæsium, ammonium, and thallium and the permanganates of rubidium, cæsium, and ammonium are not. Here, again, those salts which do form parallel growths are characterised by a closeness of molecular volume to those of the minerals on which they are deposited, while similarity of angle (or of axial ratios) is not sufficient to induce a parallel growth. If the above substances be arranged in order of topic axes, it is seen that potassium perchlorate and permanganate fall next to the three minerals mentioned.

Since calcite and sodium nitrate resemble each other so closely in all their physical properties, and since calcite relieves supersaturation in a metastable solution of the nitrate, the conclusion is drawn that these isostructural substances are also to be regarded as isomorphous, although mixed crystals are not obtainable.

Many unsuccessful attempts were made to obtain regular growths of other salts on other minerals, more especially of cubic salts on cubic minerals and potassium nitrate on aragonite; but regular growths of potassium bromide, iodide, and nitrate and sodium nitrate on mica, and of quinol on calcite, were obtained.

All the perchlorates and permanganates mentioned yield parallel growths on each other, but it was found that pairs of isomorphous salts, the molecular volumes of which are almost identical, form zonal growths ("Schichtkrystalle") rather than parallel growths.

83. "Constitution of salicin. Synthesis of pentamethyl salicin."

By James Colquhoun Irvine and Robert Evstafieff Rose.

Salicin was alkylated by means of the joint action of silver oxide and methyl iodide, with the production of pentamethyl salicin. The process was carried out in the first instance in methyl-alcoholic solution, and, after the alkylation had proceeded far enough, methyl iodide was used as solvent. The product crystallised in delicate needles (m. p. 62—64°), readily soluble in organic solvents and giving $[\alpha]_D^{20^\circ} - 52 \cdot 15^\circ$ in alcoholic solution.

Emulsin was found to be without action on the compound, and even dilute mineral acids readily converted it into a resinous mass resembling saliretin. The hydrolysis was therefore carried out indirectly by prolonged heating at 100° of a solution of the substance in methyl alcohol containing 0·25 per cent. of hydrochloric acid. Tetramethyl glucose was thus produced and afterwards converted into the equilibrium mixture of α- and β-tetramethyl methylglucosides. The alkylated glucosides were isolated and then hydrolysed to give tetramethyl glucose (m. p. 84—86°).

This reaction proves that salicin (and hence also helicin and populin) contains the same γ-oxidic linking as the methylglucosides and sucrose.

Further evidence on this point was obtained in the synthetical preparation of pentamethyl salicin. On heating saligenin and tetramethyl glucose to 120° in benzene containing 0·25 per cent. of hydrochloric acid, condensation took place with the formation of a mixture of saligenin tetramethyl glucosides and octamethyl glucosidoglucoside. After separation of the alkylated dissaccharide, the mixture was methylated by the silver oxide reaction and a compound, identical in every respect with the pentamethyl salicin prepared directly from the glucoside, was isolated from the product.

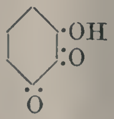
84. "A product of the action of *iso*amyl nitrite on pyrogallol."

By Arthur George Perkin and Alec Bowring Steven.

When an alcoholic solution of pyrogallol is oxidised with acetic acid and *iso*amyl nitrite, a small quantity (1·3 per cent.) of pale salmon-coloured leaflets separate (m. p. 203°). The main bulk of this product is colourless, may be obtained as minute prisms melting at 206—208° with effervescence, and has the composition $C_6H_4O_3$. With acetic acid and zinc dust it gives pyrogallol, with acetic anhydride and zinc dust *triacetylpyrogallol* (m. p. 160—162°); its acetyl derivative,

$$C_6H_3O_3(C_2H_3O),$$

forms colourless leaflets (m. p. 283—285°), and also yields triacetylpyrogallol in a similar manner. The substance $C_6H_4O_3$ dissolves sparingly in boiling acetic acid and alcohol with some decomposition, and by means of boiling water yields purpurogallin, $C_{11}H_8O_5$. The reaction studied in detail with the crude substance (m. p. 203°) showed that in this way a compound $C_{12}H_{10}O_7$? (colourless prisms, m. p. 242—243°) and an orange-brown resin, both readily soluble in water, are also formed. Owing to the poor yield it has not been possible to study this product further, but it appears likely that it may consist of *hydroxy-o-benzoquinone*:



85. "A reaction of ellagic and flavellagic acids."

By Arthur George Perkin.

When ellagic acid is heated at about 230° with 100 per cent. sulphuric acid, it is oxidised with formation of a new compound which crystallises from pyridine in small, yellow, prismatic needles and is soluble in strong alkalis with a greenish-yellow tint, changing to blue on dilution. It appears to have the formula $C_{14}H_6O_{10}$ (found $C = 50{\cdot}01$; $H = 2{\cdot}17$), gives a *hexacetyl* derivative [needles, $C_{14}H_{10}(C_2H_3O)_6$, m. p. 324—329°; found $C = 53{\cdot}18$; $H = 3{\cdot}32$; $C_{14}H_6O_{10} = 57{\cdot}24$], and dyes mordanted fabrics more readily than ellagic acid. Flavellagic acid behaves similarly [found for $C_{14}H_6O_{10}$, $C = 50{\cdot}09$; $2{\cdot}08$; and for $C_{14}O_{10}(C_2H_3O)_6$, $C = 53{\cdot}12$; $H = 3{\cdot}34$ per cent.].

86. "Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines." By Oliver Charles Minty Davis.

In the interaction of ethyleneaniline and the ethylenetoluidines with the thiocarbimides, several instances of steric hindrance were observed, the position of the substituent methyl group in the ethylenetoluidines and the tolylthiocarbimide having an important bearing both on the time of reaction and also on the nature of the product.

One molecule of ethyleneaniline unites with two molecules of allyl-, phenyl-, *o*-tolyl-, or *p*-tolyl-thiocarbimide to form symmetrical dithiocarbamide derivatives, but with *m*-tolylthiocarbimide only 1 molecule of each unites to form an asymmetrical substituted thiocarbamide. Ethylene-*o*-toluidine reacts with difficulty to give asymmetrical derivatives with phenyl-, *m* tolyl-, and *p*-tolyl-thiocarbimides, whilst with allyl- and *o*-tolyl-thiocarbimides the yield was exceedingly small. Ethylene-*m*-toluidine gives symmetrical derivatives with phenyl- and *p*-tolyl-thiocarbimides, but with allyl-, *o*-tolyl-, and *m*-tolylthiocarbimides asymmetrical derivatives result. Ethylene-*p*-toluidine gives an asymmetrical derivative with *m*-tolylthiocarbimide, but with other thiocarbimides symmetrical derivatives are formed.

With the ethylenetoluidines, the ortho- and meta-positions therefore seem to modify the reactions, but with the thiocarbimides the meta-position only has this effect.

The foregoing compounds interact with mercuric oxide in alcoholic solution when heated at about 140° in sealed tubes, oxygen replacing sulphur. The product from ethyleneaniline and phenylthiocarbimide appears to be identical with a compound synthesised from ethyleneaniline and phenylcarbimide.

At the next Ordinary Meeting, on **Thursday**, May **3rd**, 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following paper will be read :

"The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds." By E. C. C. Baly, E. G. Marsden, and A. W. Stewart.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 3rd, 1906.

Barrett, Ernest, B.Sc.,
56, Elswick Road, Lewisham, S.E.

Schoolmaster. Three years' study of Chemistry at University College, London, under Sir William Ramsay. Took the B.Sc. degree of London University with 2nd class honours in Chemistry in Oct., 1905. Now engaged in research work under Dr. Lapworth at Goldsmiths' College, New Cross.

J. Norman Collie. Samuel Smiles.
Edward C. Cyril Baly. Arthur Lapworth.
N. T. M. Wilsmore.

Beckett, Richard Henry,
Inval, Haslemere, Surrey.

Professor of Chemistry, Nagpur, and Government Chemist to the Central Provinces, India. Obtained degree of B.Sc. (Lond.), with First Class Honours in Chemistry. Teaching Associate of the Royal College of Science in Chemistry. Two years assisted in teaching Chemistry in the laboratories of the Royal College of Science.

William A. Tilden. Chapman Jones.
M. O. Forster. James C. Philip.
G. T. Morgan.

Birt, Roderick Harold Capper,
54, Shooters Hill Road, Blackheath, S.E.

Appointed to post as Science Master at Radley College from January next. B.A. (Oxon.), 2nd Class Final Honours, School of Chemistry, 1905.

Wm. Odling. W. W. Fisher.
H. B. Baker. D. H. Nagel.
Allan F. Walden. Leonard G. Killby.,

Chamberlain, Percy Garratt,

3, Market Place, Rugby.

Analytical Chemist. 2nd Class Natural Sciences Tripos, 1902 (Part I); Caius College, Cambridge, B.A., 1902, M.A., 1906. Studied Analytical Chemistry under Prof. Fresenius at Wiesbaden, 1902—1903.

M. M. Pattison Muir.
S. Ruhemann.
R. S. Morrell.
G. Stallard.
A. G. Chamberlain.

Chrystall, Edwin Rodney,

Forest Villa, Prince's Road, Buckhurst Hill, Essex.

Student of Chemistry at University College for 2½ years.

William Ramsay.
Samuel Smiles.
Edward C. Cyril Baly.
N. T. M. Wilsmore.
J. Norman Collie.
J. K. H. Inglis.

Cooper, Herbert Reginald,

Redington, Northwood, R.S.O.

Student at University College. 3½ years in Sir W. Ramsay's Laboratory at University College, London.

William Ramsay.
J. Norman Collie.
N. T. M. Wilsmore.
Edward C. Cyril Baly.
Samuel Smiles.

Davidson, Charles,

37, Herriot St., Pollokshields, Glasgow.

Analytical Chemist. Chief Chemist with Messrs. Alex. Cross and Sons, Ltd., Glasgow (Manufacturers of Vitriol, Chemical Fertilisers, &c.); author of papers on "Estimation of Nitric Nitrogen" and "Mechanical Calculation of Weight of Vitriol in Chambers" (in "Chemical News"); Member of Society of Chemical Industry.

Alexander M. Forrester.
Thomas Taylor.
W. S. Curphey.
A. M. Neilson.
John Wm. Biggart.

Dickson, William,

Branksome, Bridge of Weir.

Analytical Chemist. Two years as pupil and one as assistant with R. R. Tatlock and Thomson, Public Analysts; 3 sessions under Profs. Henderson and Gray in Glasgow Technical College; 2 years in Public Works Laboratories; at present engaged in chemical research (Pharmaceutical).

Thomas Gray.
G. G. Henderson.
R. R. Tatlock.
R. T. Thomson.
James McLeod.
Horatio Ballantyne.

Duncan, Robert K.,

Present address: c/o Harper & Brothers, 45, Albemarle Street, W. Permanent address: University of Kansas, U.S.A.

Professor of Chemistry, University of Kansas, U.S.A. Author of *The New Knowledge* and of several contributions to scientific journals. Graduate of the University of Toronto, with first-class honours. Fellow of Clark University, Worcester, Mass., U.S.A. Professor in Washington and Jefferson College. Just appointed Professor in the Univ. of Kansas.

William Ramsay.
J. Norman Collie.
F. N. A. Fleischmann.
G. Carey Foster.
Edward C. Cyril Baly.

Feilmann, Ernest,

2A, Dartmouth Road, Brondesbury, London, N.W.

Chemist. B.Sc. (Lond.), Ph.D., F.I.C.; late 1851 Research Scholar. 10 months research chemist with Messrs. Levinstein, Ltd., Manchester. 4 years research chemist with "The Clayton Aniline Co., Ltd.," Manchester. 1½ years works chemist with Messrs. Brooke, Simpson, and Spiller, Ltd., London. Joint paper on "A Taint in Milk," with J. Golding, *J. Soc. Chem. Ind.*, 1905.

Frank Clowes.
C. F. Cross.
Frank Evershed.
E. T. Shelbourne.
Edward Bevan.

Foucar, James Louis,

20, St. John's Park, Blackheath, London, S.E.

Chemist. Bachelor of Science, London University, Honours in Chemistry, qualified for Honours in Experimental Physics and Geology, an earnest student of science in general and of chemistry in particular.

Rudolph Messel.
Alfred Gordon Salamon.
Otto Hehner.
Bernard Dyer.
Alex. McKenzie.
O. Silberrad.
H. F. C. Goltz.

Foy, O. Bertram,

16, Burlington Road, Dublin.

Prof. of Experimental Science, H.M. Training College for Teachers, Drumcondra, Dublin. Have been for ten years principal Lecturer and Demonstrator in Chemistry, City of Dublin Technical Schools. Examiner in Chemistry to the Board of Intermediate Education and to the Department of Technical Instruction for Ireland for over five years. Author of: "Elements of Natural Philosophy," edited by

T. A. Finlay, S.J.M.A., F.R.U.I.; "The Balance, its Construction and Use," pamphlet issued by the Board of Technical Instruction, &c.

Edmund M. Rich. Wm. J. Wren.
A. O'Farrelly. *J. Hawthorne.*
Sydney Young.

Gardner, Edward,

70, Parliament Hill Mansions, Highgate Road, N.W.

Analytical Chemist and Metallurgist. I was educated at Tonbridge School and Finsbury Technical College. Since 1895, I have been with Messrs. Johnson and Matthey, Hatton Garden, as Chemist and Analyst.

George Matthey. R. Meldola.
John S. Sellon. C. H. Desch.
Francis H. Carr.

Garvey, Richard Godfrey Hamilton,

25, Park Mansions, Battersea.

Mining Engineer. Mining Engineer engaged on water-softening and purifying, metallurgy and assaying. Four years student of Chemistry at Battersea Polytechnic.

John Wilson. J. L. White.
J. Hart-Smith. S. I. Crookes.
H. W. Coupe-Annable.

Hall, Richard John,

"Sandycroft," Serpentine Rd., Egremont, Liverpool.

Science Teacher, Wallasey Grammar School and Technical Classes. M.Sc., Honours School of Chemistry, Victoria University. A.I.C. (Branch "D"—Organic Chemistry).

J. Parry Laws. Sydney D. Stennitt.
Rudolf Lessing. Herbert Henstock.
J. W. Kynaston.

Hills, James Stuart,

225, Oxford Street, W.

Pharmaceutical and Analytical Chemist. Associate of the Institute of Chemistry. Pharmaceutical Chemist. Salters' Research Fellow (Chemistry), 1903—1905. Original work: "Linin" [J.C.S., 87, 327], in conjunction with Prof. W. Palmer Wynne.

W. Palmer Wynne. John M. Thomson.
J. Norman Collie. Herbert Jackson.
Arthur W. Crossley.

Lattey, William Tabor,

Corpus Christi College, Cambridge.

Undergraduate.

R. T. Lattey.
H. B. Baker.
L. C. F. Oldfield.
H. O. Jones.
W. J. Sell.

McCombie, Hamilton,

The University, Birmingham.

Lecturer and Demonstrator in Chemistry. M.A. (Aberd.), A.R.C.Sc. (Lond.), A.I.C., B.Sc. (Lond.), Ph.D. (Strass.).

F. R. Japp.
William A. Tilden.
M. O. Forster.
G. T. Morgan.
James C. Philip.
Percy F. Frankland.
Alex. Findlay.
Chapman Jones.

Murray, Thomas Jenkins,

The University, Birmingham.

Lecturer and Demonstrator in Chemistry, University of Birmingham. Ph.D. (Leipzig), formerly Lecturer and Demonstrator in Chemistry at the Glasgow and West of Scotland Technical College.

G. G. Henderson.
Thomas Gray.
Percy F. Frankland.
Alex. Findlay.
J. K. H. Inglis.

Oliver, Edgar Gall,

Chigwell School, Essex.

Science Master. M.A. (Cantab.). Foundation Scholar and Prizeman of Downing College, Cambridge. Now Science Master at Chigwell, and am desirous of keeping in touch with Chemical Progress.

H. Jackson.
Eustace Coddington.
V. Seymour Bryant.
T. Luxton.
Charles T. Heycock.
T. A. Nightscales.

Ormerod, Ernest,

8, Leopold Road, Wimbledon, S.W.

Research Chemist. Salters' Co.'s Research Fellow at the Central Technical College, London. Graduated B.Sc. (Vict.), 1901, M.Sc. (Vict.), 1903, Ph.D. (Bâle), 1905. Have held the Levenstein Research Exhibition at Owens College and the Priestley Research Scholarship at Birmingham University. Five years' research work under Professors

Perkin, Frankland, and Bamberger. Late private assistant to Prof. Bamberger at Zürich.

Henry E. Armstrong.
Gerald T. Moody.
William A. Davis.
Robert J. Caldwell.
William Robertson.
Edward Horton.
J. H. Johnston.

Richardson, Lawrence George,
14, Ashgrove, Horton, Bradford.

Analytical, Consulting, and Dyer's Chemist. Student at Bradford Technical College from January, 1899, to July, 1901. Private Assistant to Prof. W. M. Gardner from July, 1901, to December, 1901. Chemist at Bowling Dyeworks (Edwd. Ripley & Son, Ltd.), from 1902 to December, 1905.

Walter M. Gardner.
A. B. Knaggs.
Joseph R. Denison.
Thorp Whitaker.
B. North.

Scouller, Walter Daly,
7, Stamp Office Place, Wakefield.

Chemist in the West Riding of Yorkshire Rivers Board Laboratory; studied science and industrial chemistry at the Yorkshire College (now University of Leeds), 1896—1900. Graduated B.Sc. (Vict.) in 1899. Since 1900, chemist in the West Riding Rivers Board Laboratory.

Arthur Smithells.
J. B. Cohen.
H. R. Procter.
C. E. Whiteley.
W. Lowson.
H. T. Calvert.

Sommerville David,
31, Manor House, Marylebone.

B.A. (Chemistry and Physiol.), M.D., &c. Lecturer in Public Health, King's College, London. Late Demonstrator of Physiology, St. Thomas's Hosp. Med. Schl., and Demonstrator of Toxicology, King's College, London. Physician. Author of Practical Sanitary Science (a Handbook for the Public Health Laboratory). Author of various papers on Sewage, Foods, Standardisation of Disinfectants, &c.

R. Meldola.
Rudolf Lessing.
Herbert Jackson.
Patrick H. Kirkaldy.
John M. Thomson.
D. Northall Laurie.

Spencer, James Frederick,
134, Rice Lane, Walton, Liverpool.

B.Sc. (Vict.), M.Sc. (L'pool), Ph.D. (Breslau). Have published in the *Society's Journal*, *Zeitschrift für Anorganische Chemie*, and *Zeit-*

schrift für Elektrochemie, on Pyridine and Furfurol compounds, and several papers on Thallium and on Amalgams.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Samuel Smiles.
Edward C. Cyril Baly. W. Lester Alton.

Sproxton, Foster,

Uplands, Alexandra Park Road, Wood Green, N.

Research Student. B.Sc. London (Honours Chemistry), 1905. Research Student at University College.

F. N. A. Fleischmann. Edward C. Cyril Baly.
Samuel Smiles. A. W. Stewart.
W. B. Tuck.

Storey, Francis W.,

42, Ellerdale Street, Lewisham, S.E.

Teacher. Has obtained his B.Sc. degree of London University in 1905; worked for three years in the chemical laboratories of University College, London, at Analytical Chemistry; is training for a teacher of science.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Edward C. Cyril Baly.
W. Lester Alton.

Tempany, Harold Augustine,

St. Johns, Antigua, B.W.I.

Assistant Govt. Analyst for Leeward Islands. B.Sc. London. Associate Institute Chemistry. Studied at University College, London. Formerly second assistant chemist to Messrs. Gorton Hill & Co. Part author of papers on "Inversion of Cane Sugar in presence of Milk Constituents" and "The Polarimetric Determination of Sucrose."

Francis Watts. W. Lester Alton.
Leonard Temple Thorne. Herbert Jackson.
William Ramsay. *E. Haynes Jeffers.*
J. Norman Collie.

Turner, George Augustus,

"Alma House," Strandtown, Belfast.

Chemist. At the South London School of Pharmacy from January 1902 till October 1903. Member of the Pharmaceutical Society of Great Britain and also the Assistant's qualification of the Pharmaceutical

Society of Ireland. Is desirous of coming into closer contact with pure Chemistry and its progress.

A. H. M. Muter.
Robert Barklie.
J. W. Epps.
Will. F. Mawer.
A. Percy Hoskins.
John H. B. Wigginton.
John Muter.

Watson, John Adam,

8, Powis Gardens, Notting Hill, W.

At present a Student at the Central Technical College, engaged in research work under Professor H. E. Armstrong.

H. E. Armstrong.
Gerald T. Moody.
T. Martin Lowry.
William A. Davis.
William Robertson.
Edward Horton.

West, John Henry,

11, Sydney St., Chelsea, S.W.

Chief Chemist to the Kennicott Water Softener Co., 29, Gt. St. Helens, E.C. Associate of the City and Guilds Institute in the Department of Applied Chemistry; Joint author with Dr. T. M. Lowry of paper on "Persulphuric Acids," published in *Proc. Chem. Soc.*

Henry E. Armstrong.
F. R. Mallet.
William A. Davis.
T. Martin Lowry.
Gerald T. Moody.
Robert J. Caldwell.
William Robertson.

Wiffen, Henry John,

17, Albany Road, Manor Park, E.

Manufacturing and Analytical Chemist. Certificates from the City and Guilds, Organic and Inorganic. Five years Assistant Chemist, Great Eastern Railway Stores Laboratory. Chemist for six years with Messrs. Herring, Giles, & Co., Stratford, E.

D. G. Riddick.
T. FitzGibbon.
E. Haynes Jeffers.
Geo. Patterson.
L. T. Thorne.

Wyatt-Edgell, Cecil,

Cowrey Place, Exeter.

Chief Science Master, High Sch., Newcastle, Staffs. 2nd Cl. Honours Chem. Finals (Oxf. Univ.), 1904.

H. B. Baker.
W. W. Fisher.
Allan F. Walden.
N. V. Sidgwick.
Leonard G. Killby.
A. Angel.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I (3):—

Gupta, Hem Chandra Dutt,

"Guptanibar," Krishnagar (Dist. Nadia), Bengal.

Professor of Chemistry, Tej Narayan Jubilee College, Bhagalpur, Bengal. Studied Chemistry for some 3 years at the Presidency College, Calcutta; took the degree of M.A. of the Calcutta University in Chemistry. Professor of Chemistry in the T. N. Jubilee College, Bhagalpur, Bengal.

J. B. Bhaduri. P. C. Rây.
J. Sen.

Mukerjee, Ram Chandra, B.A.,

Jaipur, Rajputana, India.

Professor of Chemistry, Maharaja's College, Jaipur. Has studied Chemistry for several years and is at present employed as Professor of Chemistry, Maharaja's College, Jaipur, where he has to teach Theoretical and Analytical Chemistry.

A. Sanyal. *Gopal Ch. Banerjee.*

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 14/5/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 309.

Thursday, May 3rd, 1906, at 8.30 p.m. Professor H. E. Armstrong, F.R.S., Past-President, in the Chair.

Messrs. H. C. Irving and W. H. Glover were formally admitted Fellows of the Society.

The Chairman gave expression to the sense of loss sustained by the Chemical Society in the death of Professor Pierre Curie, which followed an accident on April 19th. The meeting endorsed the letter of condolence addressed by the President to Mme. Marie Curie, an Honorary and Foreign Member of the Society.

Certificates were read for the first time in favour of Messrs. :

Arthur John Berry, 5, University Gardens, Glasgow.
William John Bowis, Ph.D., 97, North Road, West Bridgford, Notts.
Harold Calam, B.Sc., 71, Cemetery Road, Beeston Hill, Leeds.
John Denton, Horton Villa, Bradford.
Bertie James Eaton, Kuala Lumpar, Federated Malay States.
Arthur Burton Shepherd, B.Sc., 18, Stafford Street, Hull.
Fred Smith, Cliff House, Bruntcliffe, near Leeds.
Henry Wren, 22, Stapleton Hall Road, Stroud Green, N.
George Young, B.A., B.Sc., 38, Havelock Street, Sheffield.

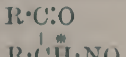
A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Ernest Barrett, B.Sc.
Richard Henry Beckett, B.Sc.
Roderick Harold Capper Birt, B.A.
Percy Garratt Chamberlain, M.A.
Edwin Rodney Chrystall.
Herbert Reginald Cooper.
Charles Davidson.
William Dickson.
Robert K. Duncan.
Ernest Feilmann, B.Sc., Ph.D.
James Louis Foucar, B.Sc.
P. Bertram Foy.
Edward Gardner.
Richard Godfrey Hamilton Garvey.
Hem Chandra Dutt Gupta, M.A.
Richard John Hall, M.Sc.
James Stuart Hills.
William Tabor Lattey.
Hamilton McCombie, M.A., B.Sc., Ph. D.
Ram Chandra Mukerjee, B.A.
Thomas Jenkins Murray, Ph.D.
Edgar Gale Oliver, M.A.
Ernest Ormerod, M.Sc., Ph.D.
Lawrence George Richardson.
Walter Daly Scouller, B.Sc.
David Sommerville, B.A., M.D.
James Frederick Spencer, M.Sc., Ph.D.
Foster Sproxton, B.Sc.
Francis W. Storey, B.Sc.
Harold Augustine Tempany, B.Sc.
George Augustus Turner.
John Adam Watson.
John Henry West.
Henry John Wiffen.
Cecil Wyatt-Edgell, B.A.

Of the following papers, those marked * were read:

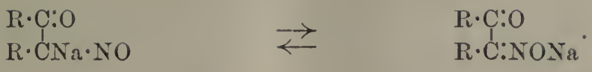
*87. "The relation between absorption spectra and chemical constitution. Part V. The *iso*nitroso-compounds." By Edward Charles Cyril Baly, Effie Gwendoline Marsden, and Alfred Walter Stewart.

In the previous papers it was shown that when two carbonyl groups are adjacent to one another in a compound, the process of isorropesis is set up between the residual affinities of the oxygen atoms with the result that an absorption band is produced in the visible blue region of the spectrum and the compounds are coloured yellow. The principle was extended to the quinones and to the nitrophenols and nitroanilines. A similar condition exists in the *iso*nitroso-compounds, and in the present paper the yellow colour of these substances in alkaline solution is explained. From observations of the absorption spectra of several *iso*nitroso-compounds in neutral and alkaline solution, it is found that the free substances most probably have the constitution



$\begin{array}{l}R\cdot C{:}O\\ \;|\\ R\cdot C\overset{*}{H}\cdot NO\end{array}$,

but in presence of sodium hydroxide the hydrogen atom marked with a star is replaced by sodium and becomes labile, so that a tautomeric process occurs, thus:



$$\begin{matrix} R\cdot C{:}O \\ | \\ R\cdot CNa\cdot NO \end{matrix} \quad \rightleftarrows \quad \begin{matrix} R\cdot C{:}O \\ | \\ R\cdot C{:}NONa \end{matrix}.$$

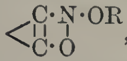
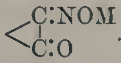
a. *b.*

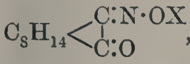
Isorropesis then takes place between the $>C{:}O$ and $>C{:}N-$ groups, the tautomeric process being the actuating mechanism. The compounds are therefore yellow in alkaline solution, owing to the presence of an absorption band in the visible blue region of the spectrum, which is due to the isorropesis. There is thus complete analogy between the *iso*nitroso-bodies and quinonemonoxime. An analogous condition is shown to exist in the case of *iso*nitrosocamphor.

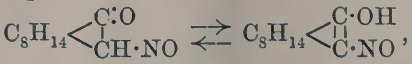
DISCUSSION.

Dr. HEWITT drew attention to the way in which Mr. Baly had represented both nitroso- and *iso*nitroso-camphor as equilibrium mixtures, one particular configuration of the molecule being common to both substances. If X be in equilibrium with Y, and Y in turn with Z, then X and Z must also be in equilibrium, and it should be impossible to isolate two different substances, one containing molecules of configurations X and Y and the other molecules of configurations Y and Z in the case of rapid velocities of transformation.

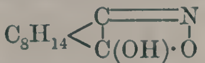
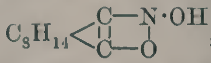
Dr. LOWRY considered it very improbable that any of the colourless compounds to which Mr. Baly had referred possessed the true nitroso-formula $>CH\cdot NO$, since this group usually produces a blue or green coloration. He was surprised that no reference had been made to Beckmann's isoxime-formula, $>C<\overset{NH}{\underset{O}{|}}$; nitrogen-ethers derived from the isoximes had been prepared in several cases, and nearly all the colour changes to which Mr. Baly had referred might be explained by the conversion of a coloured oxime into a colourless isoxime and *vice versâ* (compare *B.A. Report*, Cambridge, 1904, p. 222). He strongly objected to the application of the term "tautomerism" to substances such as *iso*nitrosocamphor and ethyl acetoacetate; these substances were certainly not "tautomeric" in the sense of Laar's hypothesis, and it would be preferable to describe them in accordance with their actual behaviour as examples of labile or dynamic isomerism.

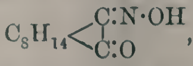
Mr. WM. ROBERTSON asked if Mr. Baly had examined the absorption spectra of the simple oximes. From the physical evidence, such as refractive indices, it would appear that the oximes and their salts were identical in structure, whereas in the case of the *iso*nitroso-compounds a very different condition of affairs obtained. With regard to the *iso*nitrosocamphors, he was of opinion that the stable *iso*nitrosocamphor and its oxygen ethers contain the grouping  $<\begin{array}{l}\mathrm{C\cdot N\cdot OR}\\ \|\quad|\\ \mathrm{C\cdot O}\end{array}$, and that the salts derived from the unstable isomeride are represented by the grouping  $<\begin{array}{l}\mathrm{C{:}NOM}\\ |\\ \mathrm{C{:}O}\end{array}$.

Dr. Forster stated that without having had an opportunity of examining the detailed communication, he had some difficulty in dealing with Mr. Baly's references to the views he had from time to time expressed regarding the constitution of *iso*nitrosocamphor, but it seemed to him that the most important observation on that point which Mr. Baly and his colleagues had brought forward was the close similarity between the absorption spectra of the stable *iso*nitrosocamphor and its *O*-alkyl ethers. Experiments of a merely chemical nature had made it clear that these ethers and the colourless benzoyl derivative are not compounds of the type  $\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C{:}N\cdot OX}\\ |\\ \mathrm{C{:}O}\end{array}$, and the obvious inference is that the stable *iso*nitrosocamphor likewise belongs to a different class. Nevertheless, he was quite unable to accept the explanation of the authors, who, he understood, represented the stable modification as an equilibrium mixture,



$$\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C{:}O}\\ |\\ \mathrm{CH\cdot NO}\end{array} \rightleftarrows \mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C\cdot OH}\\ \|\\ \mathrm{C\cdot NO}\end{array},$$

a system which should surely display some characteristics of a true nitroso-compound. If the stereochemical theory applied to *iso*nitrosocamphor had to be abandoned, as to which the speaker was not completely convinced, a more satisfactory explanation of the difference between the two modifications of *iso*nitrosocamphor lay in the expression  $\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C{=\!=}N}\\ |\qquad\quad|\\ \mathrm{C(OH)\cdot O}\end{array}$ (*pseudo*-form), which accounted for the readiness with which *a*-camphornitrilic acid arose from the colourless derivatives on hydrolysis. As an alternative to this might be offered the similar formula  $\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C{-}N\cdot OH}\\ \|\quad|\\ \mathrm{C{-}O}\end{array}$, but, except in so far as it presented a smoother transposition from the unstable form



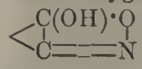
$$\mathrm{C_8H_{14}}<\begin{array}{l}\mathrm{C{:}N\cdot OH}\\ |\\ \mathrm{C{:}O}\end{array},$$

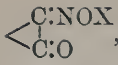
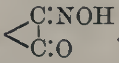
it possessed no great advantage over the *pseudo*-form, although, in the speaker's opinion, certainly preferable to the isoxime constitution.

The Chairman congratulated the meeting on the fact that the paper had been so well discussed, and subjected to the proper criticism to which all papers presented to the Society should be open; it was clearly the general opinion that the conclusions arrived at were unsound. He could not agree that the word "isorropesis" coined by Mr. Baly was a good one, and he protested against its introduction; neither was it necessary, nor did it express the conception which had been brought forward. Apparently it indicated a process in which a state of equipoise or equilibrium was arrived at: to express which no new word was required; in reality, the idea put forward was that the production of absorption bands was due to a wobble or metamorphosis, to change of form: which also could be expressed without a new word. There was a growing practice among scientific workers, whenever a vague new conception was arrived at, to wrap it up in a new word which few could understand. He desired, with whatever authority the Chair gave, to protest in the most emphatic manner possible against the practice. He agreed with previous speakers that nitroso-formulæ such as were put forward, could not be used for the colourless compounds under consideration: substances so constituted would be highly coloured. Mr. Baly objected to the interpretation put upon the term isorropesis, and denied that it meant wobble generally; it appeared that he limited it strictly to the wobble involved in the passage from the ketonic to the linked oxygen form of quinone.

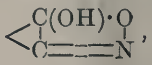
Mr. Baly said, in reply to Dr. Hewitt, that the existence of one configuration being common to both processes was no objection. Two possibilities of labile isomerism exist in *iso*nitrosocamphor, and one of these they connected with the unstable variety and the other with the stable variety. The existence of a common configuration accounts for the ease with which unstable *iso*nitrosocamphor passes over into the stable form.

In reply to Dr. Lowry, he thought that there was no direct evidence that the group $>CH\cdot NO$, as suggested, possessed a blue or green colour. The isoxime formula did not seem capable of explaining the absorption curves obtained with the *iso*nitroso-compounds. In alkaline solution these bodies all show a strong absorption band in the ultra-violet analogous to ethyl acetoacetate in alkaline solution. Such a band as this does not seem capable of explanation by an equilibrium between the isoxime and oxime form; it must be due to the same type of labile isomerism as is occurring in ethyl acetoacetate.

In reply to Mr. Robertson, the absorption curves show that the stable form of *iso*nitrosocamphor in neutral solution possesses the same configuration as Dr. Forster's oxygen alkyl ethers. They therefore attributed the formula  $<\begin{array}{l}\mathrm{C(OH)\cdot O}\\ \;\vert\qquad\;\;\vert\\ \mathrm{C{=}{=}{=}N}\end{array}$ to this substance. To the coloured derivatives of the unstable form they attributed the formula

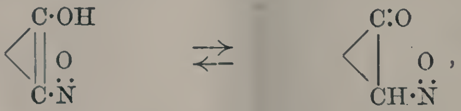
 $\left\langle\begin{array}{l}\mathrm{C{:}NOX}\\ \mathrm{C{:}O}\end{array}\right.$, but if the unstable form were colourless it could not have the formula  $\left\langle\begin{array}{l}\mathrm{C{:}NOH}\\ \mathrm{C{:}O}\end{array}\right.$.

In reply to Dr. Forster, Mr. **Baly** apologised for not making himself clear upon the suggestions his colleagues and he brought forward. They were firmly of the opinion that the stable form of *iso*nitrosocamphor in neutral solution was Dr. Forster's own pseudo-form,



$$\left\langle\begin{array}{l}\mathrm{C(OH){\cdot}O}\\ \mathrm{C{=\!=\!=\!=}N}\end{array}\right.,$$

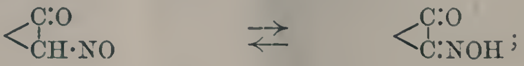
but that in alkaline solution the ring was broken and that a process of labile isomerism was set up which could be best expressed by saying there was equilibrium between



$$\left\langle\begin{array}{l}\mathrm{C{\cdot}OH}\\ \qquad\mathrm{O}\\ \mathrm{C{\cdot}\ddot{N}}\end{array}\right. \rightleftarrows \left\langle\begin{array}{l}\mathrm{C{:}O}\\ \qquad\mathrm{O}\\ \mathrm{CH{\cdot}\ddot{N}}\end{array}\right.,$$

a. *b.*

the colour in alkaline solution being due to the parallel linking in *a*. Similarly, in the unstable form their view was that in alkaline solution the labile tautomerism could be best expressed by

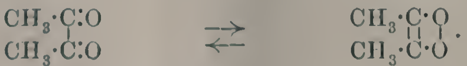


$$\left\langle\begin{array}{l}\mathrm{C{:}O}\\ \mathrm{CH{\cdot}NO}\end{array}\right. \rightleftarrows \left\langle\begin{array}{l}\mathrm{C{:}O}\\ \mathrm{C{:}NOH}\end{array}\right.;$$

b. *c.*

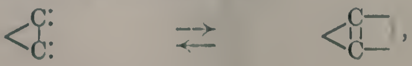
the colour was due to the isorropesis occurring with form *c*. It was difficult to give a formula to the unstable form in neutral solution, as its colour was not absolutely known.

There seemed to be confusion as to the meaning of the term isorropesis and he would like to state what the process consists in. The simplest case is that of diacetyl, in which compound the residual affinities on the ketonic oxygen atoms disturb one another, with the result that an oscillation is set up which can, perhaps, be graphically expressed:



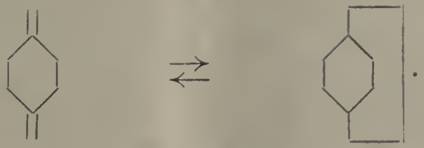
$$\begin{array}{l}\mathrm{CH_3{\cdot}C{:}O}\\ \mathrm{CH_3{\cdot}C{:}O}\end{array} \rightleftarrows \begin{array}{l}\mathrm{CH_3{\cdot}C{\cdot}O}\\ \mathrm{CH_3{\cdot}C{\cdot}O}\end{array}.$$

This process has been named isorropesis and, in its broadest sense, it means an oscillation between the residual affinities of two or more adjacent atoms or groups of atoms, thus:



$$\left\langle\begin{array}{l}\mathrm{C{:}}\\ \mathrm{C{:}}\end{array}\right. \rightleftarrows \left\langle\begin{array}{l}\mathrm{C{-}}\\ \mathrm{C{-}}\end{array}\right.,$$

or



The process might also be looked on as the result of the mutual interference between two systems, each possessing possibilities of labile isomerism, as, for example, the two $CH_3\cdot CO$ groups in diacetyl.

*88. "The residual affinity of coumarin as shown by the formation of oxonium salts." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

Coumarin dissolves much more readily in concentrated hydrochloric acid than in water, and the strongly acid solution, when treated with excess of chloroplatinic acid, yields a yellow, crystalline *platinichloride*, $4C_9H_6O_2,H_2PtCl_6,4H_2O$, which is dissociated into its generators by water. 6-Aminocoumarin, ethyl-6-aminocoumarin, dimethyl-6-aminocoumarin, and the corresponding quaternary base, like other aromatic amines, all yield platinichlorides, platinibromides, and aurichlorides of the normal type, but the acyl derivatives of 6-aminocoumarin, in which the salt-forming power of the nitrogen atom is largely destroyed, resemble coumarin itself in giving rise to platinichlorides containing a greater proportion of the organic constituent. *Acetyl*-6-*aminocoumarin platinichloride* has a composition approximating to the formula

$$4(C_7H_5O_2\cdot NH\cdot CO\cdot CH_3),H_2PtCl_6,4H_2O.$$

Coumarin dissolves readily in warm fuming hydriodic acid containing free iodine, and from the dark brown solution, dark bronzy-green masses or well-defined needles separate, depending on the concentration; the product, which can be recrystallised from concentrated hydriodic acid, has the composition of a *hydriodide periodide*, $4C_9H_6O_2,HI,I_3$.

The formation of these salt-like additive compounds of coumarin agrees with the results of earlier investigators. Ebert found that this lactone yielded an extremely unstable hydrobromide (*Annalen*, 1884, **226**, 347), whilst W. H. Perkin, sen., described a dichloride and dibromide (*Annalen*, 1871, **157**, 116). Moreover, coumarin exhibits an amphoteric character in combining also with metallic oxides and hydroxides.

Discussion.

Dr. Cain referred to his paper on "The Constitution of the Ammonium Compounds" (*Mem. Manchester Phil. Soc.*, 1904, **48**, iii, No. 14), in which he had suggested formulæ for the so-called molecular compounds, similar to those now brought forward by Dr. Morgan. He did not believe in Werner's theory of "Haupt Valenz" and "Neben Valenz" as applied to the ammonium compounds, but was of the opinion that a satisfactory explanation was given by assuming the presence of triad halogen and tetrad oxygen.

Dr. Hewitt remarked that the formation of oxonium salts frequently coincided with the occurrence of another oxygen atom in the molecule, in addition to the salt-forming oxonium oxygen atom: not only in the case of pyrones and coumarins, but also with xanthone and fluorane derivatives. Dr. Cain's formulation of ammonium chloride was open to the objection that it seemed incompatible with the known ionisation of ammonium salts in aqueous solution: a difficulty in no way diminished when one applied corresponding formulæ to the tetra-alkylammonium bases and their salts.

Dr. Morgan, in reply to a question from Mr. F. H. Carr, stated that they had made many attempts to combine coumarin with metallic salts such as mercuric iodide, but without success.

89. "Brazilin and hæmatoxylin. Part VII. Some derivatives of brazilein." By Paul Engels and William Henry Perkin, jun.

Brazilein, $C_{16}H_{12}O_5$, is the colouring matter which is produced when brazilin, $C_{16}H_{14}O_5$, is oxidised in alkaline solution by means of air.

When brazilein is treated with a large excess of methyl sulphate and caustic potash, it is converted into *trimethylbrazilein*,

$$C_{16}H_9(OMe)_3O_5,$$

the formula of which was controlled by repeated analysis and the determination of the methoxy-groups by Zeisel's method.

This new orange-yellow, crystalline substance separates from solvents in two modifications, which melt at 160° and 178° respectively. It combines with formic acid, yielding *trimethylbrazilein formic acid*, which crystallises in brilliant garnet-coloured prisms, melts at 143°, and is decomposed into its components by treatment with alcohol. Trimethylbrazilein dissolves in concentrated sulphuric acid, yielding a crimson solution which soon becomes orange and, when poured into water, deposits a brilliant vermilion, crystalline precipitate which appears to be *trimethyl*iso*brazilein sulphate* (compare J. J. Hummel and A. G. Perkin, Trans., 1882, 41, 9).

When trimethylbrazilein is left in contact with an alcoholic solution of hydroxylamine, it yields *trimethylbrazilein hydroxylamine*,

$$C_{16}H_9(OMe)_3O_5,NH_2\cdot OH,$$

an almost colourless, crystalline substance which melts at about 155°

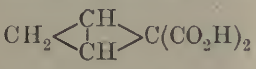
with decomposition. This substance dissolves in dilute alkalis with a yellow colour, and is decomposed, on standing, into a neutral substance of melting point 177° and trimethylbrazilein. It is also decomposed by boiling glacial acetic acid, and the solution, on cooling, deposits crystals of trimethylbrazilein.

The authors wish to reserve these new compounds for further investigation.

90. "The action of tribromopropane on the sodium derivative of ethyl malonate." By William Henry Perkin, jun., and John Lionel Simonsen.

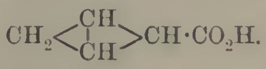
In a previous communication (Proc., 1905, 21, 256), it was shown that tribromopropane, $CH_2Br\cdot CHBr\cdot CH_2Br$, reacts with the sodium derivative of ethyl malonate with formation of an ester $C_{10}H_{15}O_2Br$.

This ester, when treated with alcoholic potash, yields an acid, $C_4H_4(CO_2H)_2$, which is decomposed on heating, with elimination of carbon dioxide and formation of the corresponding monobasic acid, $C_4H_5(CO_2H)$. Since these two acids do not decolorise bromine, are very slowly oxidised by permanganate, and are not affected by boiling with sodium amalgam, it was suggested that they are probably *dicyclobutane* derivatives of the formulæ



$$CH_2{<}\begin{matrix}CH\\|\\CH\end{matrix}{>}C(CO_2H)_2$$

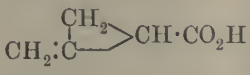
and



$$CH_2{<}\begin{matrix}CH\\|\\CH\end{matrix}{>}CH\cdot CO_2H.$$

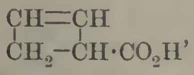
These acids have now been prepared in considerable quantities, and the determination of the magnetic rotation of their esters has proved conclusively that they cannot have the above formulæ, but that they must be unsaturated closed chain compounds.

From a careful investigation of their behaviour, the authors incline to the view that the monobasic acid must be represented by one of the constitutional formulæ



$$CH_2{:}\begin{matrix}CH_2\\|\\C\end{matrix}{>}CH\cdot CO_2H$$

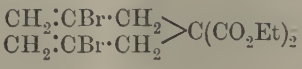
or



$$\begin{matrix}CH{=}CH\\|\qquad|\\CH_2{-}CH\cdot CO_2H\end{matrix}$$

but such formulæ are, obviously, very difficult to establish.

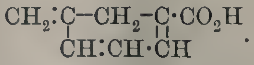
Besides the bromo-ester mentioned above, a second *bromo-ester*, $C_{13}H_{18}O_4Br_2$, is formed during the action of tribromopropane on the sodium derivative of ethyl malonate; this distils at 191° (11 mm.), and has either the constitution



$$\begin{matrix}CH_2{:}CBr\cdot CH_2\\CH_2{:}CBr\cdot CH_2\end{matrix}{>}C(CO_2Et)_2$$

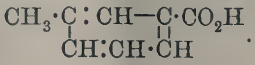
or some constitution closely allied to this.

When digested with alcoholic potash, it yields an acid of melting point 47°, which closely resembles the *pseudo*phenylacetic acids, and probably has the constitution



$$\begin{matrix}\mathrm{CH_2{:}C{-}CH_2{-}C{\cdot}CO_2H}\\ \mathrm{CH{:}CH{\cdot}CH}\end{matrix}.$$

This interesting acid instantly decolorises permanganate, and when boiled with water or mineral acids, or treated with acetic or hydrobromic acid in the cold, is converted quantitatively by molecular rearrangement into *m*-toluic acid (m. p. 110°):



$$\begin{matrix}\mathrm{CH_3{\cdot}C{:}CH{-}C{\cdot}CO_2H}\\ \mathrm{CH{:}CH{\cdot}CH}\end{matrix}.$$

For this reason the acid of melting point 47° has been named *pseudo*-m-*toluic acid.*

The further investigation of these new compounds is in progress.

91. "Pipitzahoic acid." By James McConnell Sanders.

An investigation of this substance was made by the author at the instance of the Mexican Government, with the object of correcting, if possible, the discrepancies which exist in the literature. Considerable attention is being attracted by this substance owing to its peculiar and valuable properties as a non-toxic purgative. The author describes the method of extraction from the Pipitzahoac root and the properties of the purified acid.

The formulæ of Weld ($C_{30}H_{20}O_6$) and Mylius ($C_{15}H_{20}O_3$) are rejected, the author considering that its composition is best represented by the formula $C_{10}H_{14}O_2$, it being thus isomeric with camphorquinone and similar to, although not identical with, the *iso*camphorquinone discovered by Manasse and formulated by Bredt as $\Delta^{1-4}(8)$-terpadienol (*Ber.*, 1902, 36, 3829—3843). Pipitzahoic acid is obtained in golden-yellow scales or orange crystals and melts at 104—105°; by prolonged heating above its melting point it loses carbon monoxide and carbon dioxide, giving at first a lemon-yellow sublimate, which melts at 88—89°, and finally a beautifully crystalline, colourless sublimate, which is insoluble in water, but soluble in most organic solvents. This *compound*, $C_{11}H_{14}O_2$, crystallises from acetone or benzene in glistening prisms melting at 140°, and having an odour of camphor. Its solutions are optically active, a 2 per cent. solution in alcohol having $[\alpha]_D = 77{\cdot}9°$ at 25°; it does not react with hydroxylamine or aniline, but with acetic anhydride forms a *compound*, $C_{41}H_{50}O_{10}$, which crystallises from acetone in square plates melting at

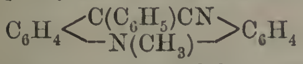
114—115°. Pipitzahoic acid is insoluble in water, but soluble in most organic solvents, its solutions being optically inactive. Its violet alkaline solution yields the unchanged substance on acidifying or by extraction with ether. It has a neutral reaction, does not contain methoxy-groups, and does not combine with sodium bisulphite. On fusion with potash, the acid gives methyl hexylene ketone and butyric acid. It forms an *oxime* (m. p. 153·7°), an aniline *compound* (m. p. 134—135°), and a *dibromide*, which is a yellowish-brown, unstable oil. It is not reduced by sulphurous acid, but easily reduced by zinc dust and acetic acid, and when distilled in a current of hydrogen over zinc pumice gives a readily oxidisable liquid which forms optically inactive fluorescent solutions in chloroform and ether. The reduction product itself is isomeric with benzylidenecamphor, $C_{17}H_{20}O$. Pipitzahoic acid seems to behave as a hydroxy-ketone, forming a resinous acetyl compound and a greenish-brown *copper* derivative, $(C_{10}H_{13}O_2)_2Cu$.

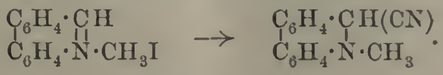
Silk may be dyed an olive-green tint by treating it with a solution of pipitzahoic acid after a preliminary mordanting with copper acetate.

92. "The constitution of the hydroxides and cyanides obtained from acridine, methyl-acridine, and phenanthridine methiodides."

By Charles Kenneth Tinkler.

From the results obtained by a study of the ultra-violet absorption spectra of the methiodides, before and after the addition of caustic soda, it is concluded that the hydroxides produced are carbinols and are constituted similarly to the hydro-compounds, as in the cases of cotarnine, hydrastinine, and phenylmethylacridol (Dobbie, Lauder, and Tinkler, *Trans.*, 1903, **83**, 598, Dobbie and Tinkler, *Trans.*, 1904, **85**, 1005, and 1905, **87**, 269).

The cyanide obtained from phenylacridine methiodide (Hantzsch, *Ber.*, 1899, **32**, 3109) gives spectra almost identical with those of hydrophenylacridine, thus affording evidence in support of the constitution  $C_6H_4{<}\begin{matrix}C(C_6H_5)CN\\ N(CH_3)\end{matrix}{>}C_6H_4$ for this substance. A colourless cyanide has been prepared from phenanthridine methiodide. The absorption spectra of the substance agree very closely with those of hydrophenanthridine, and this is only to be explained by adopting the constitution of a *pseudo*-cyanide for this substance,



$$\begin{matrix}C_6H_4\cdot CH\\ C_6H_4\cdot N\cdot CH_3I\end{matrix} \longrightarrow \begin{matrix}C_6H_4\cdot CH(CN)\\ C_6H_4\cdot N\cdot CH_3\end{matrix}.$$

93. "The constitution of ammonium amalgam."

By Miss Elizabeth Mary Rich and Morris William Travers.

The authors have determined the freezing points of a series of samples of ammonium amalgam, in which the concentration, calculated as grams of ammonium per 100 grams of mercury, varied between 0·0094 and 0·507. The value of the "molecular depression" agrees with that obtained by Tammann for solutions of other metals in mercury, leading to the conclusion that ammonium amalgam is a true solution of ammonium in mercury.

94. "Action of light on potassium ferrocyanide."

By Glyn William Arnold Foster.

When a neutral or alkaline solution of potassium ferrocyanide is exposed to light, ferric hydrate is slowly precipitated; in presence of alkali sulphide, ferrous sulphide is thrown down.

No precipitation takes place if the solutions are protected from light: the action is therefore entirely photochemical. Potassium ferrocyanide is, in solution, dissociated in the usual manner into potassium ions and the complex "ferrocyan" ions $[Fe(CN)_6'''']$: this is in absence of light. On exposure to light, this complex is dissociated into iron ions and cyan ions, and on removing the source of light the complex ferrocyan ion is regenerated. Thus no precipitation of iron can take place in absence of light.

The relations Fe : (CN) were always below the theoretical 1 : 6, and this was found to be due to the oxidation of cyanide under the influence of light to cyanate and polymerides. In presence of alkali sulphide the cyanide is almost entirely converted into sulphocyano-compounds.

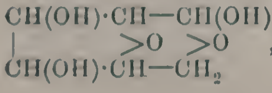
The source of light used was a mercury vapour lamp of quartz, made by W. C. Heraeus of Hanau. It was water-cooled, and, using a direct current of 5—6 amperes at 240—250 volts, gave a very intense light, rich in ultra-violet radiation.

95. "Note on the constitution of cellulose."

By Arthur George Green and Arthur George Perkin.

It is generally believed that the highest acetyl derivative of cellulose is a tetra-acetate, $C_6H_6(OAc)_4O$.

Green's formula for cellulose (*Zeit. Farb. Text. Ind.*, 1904, 3, 97),



$$\begin{array}{l} CH(OH)\cdot CH{-}CH(OH) \\ | \qquad\quad >O \;\; >O \\ CH(OH)\cdot CH{-}CH_2 \end{array}$$

, contains only three hydroxyl groups and would therefore yield a *tri*-acetate. As this formula affords a simple and direct explanation of the other reactions of cellulose, a re-examination of the acetate was desirable. Acetyl estimations of the so-called "tetra-acetylcellulose" were therefore made by three different methods: (*a*) Perkin's method (*Trans.*, 1905, **87**, 107); (*b*) alkaline saponification; (*c*) alkaline saponification combined with Perkin's method. In each case the numbers obtained agreed closely with those required for the tri-acetate, $C_6H_7(OAc)_3O_2$.

The highest acetate, therefore, like the highest nitrate and benzoate, corresponds with the presence of three hydroxyl groups in the cellulose molecule.

It is suggested that the above expression represents cellulose in its simplest or unpolymerised form, but that fibre cellulose is a colloidal aggregate of a large number of such simple molecules.

96. "Some new derivatives of pinene."
By Frederick Peacock Leach.

When pinene nitrosochloride is treated with potassium cyanate in alcohol at 50—60°, potassium chloride is precipitated, and on pouring the mixture into water a *compound*, $C_{12}H_{17}O_3N_3$, separates, which after crystallisation from alcohol melts at 238—240°. The substance is characterised by its great stability, being dissolved by hot concentrated nitric acid without undergoing change.

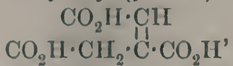
On reduction with zinc and acetic acid, carbon dioxide and ammonia are eliminated, the *compound* $C_{11}H_{18}ON_2$ being formed. This melts at 224°, and from its behaviour towards nitrous acid is most probably a ψ-carbamide, giving a well-crystallised *nitroso*-derivative melting at 159°; when the latter is reduced, the corresponding ψ-semicarbazide is formed, yielding a *benzal-ψ-semicarbazone*, $C_{18}H_{23}ON_3$, which melts at 180°. When the compound $C_{12}H_{17}O_3N_3$ is heated with concentrated sulphuric acid, carbon dioxide and ammonia are eliminated, and there is produced a *base*, $C_{10}H_{18}ON_2$, which crystallises in needles and melts at 123—125°: $C_{12}H_{17}O_3N_3 + 2H_2O = C_{10}H_{18}ON_2 + 2CO_2 + NH_3$. This compound is amphoteric, and appears to be an amino-oxime; it is obtainable also from pinene nitrosochloride by the action of ammonia.

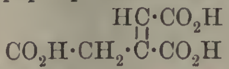
97. "Glutaconic and aconitic acids." By Siegfried Ruhemann.

Rogerson and Thorpe show in their papers (Trans., 1905, **87**, 1669, 1685; 1906, **89**, 631) on glutaconic and aconitic acids that they are unacquainted with several of my publications dealing with these acids, and they misrepresent some of my statements. I feel reluctantly obliged, therefore, to point out their errors.

After having found that ethyl aconitate, on treatment with ammonia, yields citrazinamide (*Ber.*, 1887, **20**, 3366), I applied this reaction to the β-alkyl derivatives of ethyl glutaconate, and thus arrived at the β-alkyl substitution products of 2 : 6-dihydroxypyridine. Thus methyl, ethyl, and benzyl 2 : 6-dihydroxypyridine have been obtained (Trans., 1893, **63**, 259, 874), which are oxidised by ferric chloride to yellow substances. Lately, Rogerson and Thorpe have prepared derivatives of 2 : 6-dihydroxypyridine (Trans., 1905, **87**, 1685) which contain alkyl groups in the γ-position and others with the same groups in the β- and γ-positions, and have pointed out that these derivatives react with ferric chloride in a manner different from the β-substituted 2 : 6-dihydroxypyridines (see Ruhemann, *loc. cit.*), but these chemists appear to be unaware of the fact that I had previously obtained derivatives of 2 : 6-dihydroxypyridine containing alkyl groups in the γ- and γβ-positions by the action of ammonia on the products of the union of ethyl phenylpropiolate with ethyl malonate or its homologues, and that I have also described their reaction with ferric chloride (Trans., 1899, **75**, 245). Again, in recording the properties of the αα′-dihydroxypyridines, Rogerson and Thorpe indicate the analogy which exists between these substances and resorcinol, but they seem to have overlooked the fact that I have already recorded this (*Ber.*, 1893, **26**, 1559).

By the action of ethyl sodiocyanoacetate on ethyl oxaloacetate, Rogerson and Thorpe (Trans., 1906, **89**, 640) obtained ethyl α-cyanoaconitate which, under the influence of concentrated sulphuric acid, condenses to ethyl 2 : 6-dihydroxypyridine-4 : 5-dicarboxylate. They further show that, on boiling this ester with alkali, it is transformed into citrazinic acid. They state that ethyl dihydroxycinchomerate had first been prepared by Errera and Perciabosco (*Ber.*, 1901, **34**, 3713), but they have overlooked the fact that Ruhemann and Stapleton (Trans., 1900, **77**, 250) had obtained it a year before by the action of ammonia on ethyl propenetetracarboxylate, and had described its conversion into citrazinic acid.

I am especially surprised that Rogerson and Thorpe should have misunderstood Ruhemann and Orton's statements concerning the configuration of aconitic acid. They say (p. 634) that we assigned to this acid the configuration  $\begin{matrix}\mathrm{CO_2H\cdot CH}\\ \|\\ \mathrm{CO_2H\cdot CH_2\cdot C\cdot CO_2H}\end{matrix}$, "on account of its formation from citrazinamide by the action of caustic potash at 150°, and also owing to the formation of citrazinamide by the action of ammonia on ethyl aconitate." As a matter of fact, the former reaction has never been advanced as a proof of the fumaroid structure. This was mainly derived from a careful study of the transformations of citrazinamide. I need not here enter into the arguments which support this view, because they are fully discussed in the paper to which Rogerson and Thorpe refer (Ruhemann and Orton, *Ber.*, 1894, **27**, 3449).

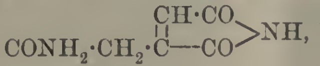
The research described in this paper points to the existence of the other possible stereoisomeride,  $\begin{array}{c}\mathrm{HC\cdot CO_2H}\\ \|\\ \mathrm{CO_2H\cdot CH_2\cdot C\cdot CO_2H}\end{array}$; it was suggested only that the latter is "probably" identical with Baeyer's aceconitic acid (*Annalen*, 1865, **135**, 306), but not put forward as our definite opinion, as Rogerson and Thorpe seem to imagine (Trans., 1906, **89**, 634).

Rogerson and Thorpe arrive at a different conclusion as to the formula of aconitic acid by assigning to it a symmetrical structure, similar to that which they give to glutaconic acid. They support this view by demonstrating the formation of the same methylaconitic acid from both ethyl-α-cyano-α-methylaconitate,

$$\mathrm{CN\cdot CMe\cdot(CO_2Et)\cdot C(CO_2Et)\colon CH\cdot(CO_2Et)},$$

and ethyl α-cyano-γ-methylaconitate,

$$\mathrm{CN\cdot CH(CO_2Et)\cdot C(CO_2Et)\colon CMe(CO_2Et)}.$$

The same criticism which Feist and Beyer (*Annalen*, 1906, **345**, 117), who succeeded in proving the existence of both stereoisomeric β-methylglutaconic acids, offer to Rogerson and Thorpe's symmetrical structure of glutaconic acid applies also to the symmetrical structure of aconitic acid. Without entering into further discussion of the conclusions at which these chemists arrive, I will only point out that if their view were correct, the action of ammonia on ethyl aconitate may be expected to yield, besides citrazinamide, a five-membered ring compound,  $\begin{array}{l}\quad\quad\quad\quad\quad\mathrm{CH\cdot CO}\\ \quad\quad\quad\quad\quad\|\quad\quad\quad\;\rangle\mathrm{NH}\\ \mathrm{CONH_2\cdot CH_2\cdot C{-}{-}CO}\end{array}$, but the formation of this compound does not take place.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 4th, 1906.

Those Fellows who received grants in June 1905, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Friday, June 1st, 1906.

CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

At the next Ordinary Meeting, on **Thursday**, May **17**th, 1906, at **8.30** p.m., the following papers will be read :

"The relation between absorption spectra and chemical constitution. Part VI. The phenylhydrazones of simple aldehydes and ketones." By E. C. C. Baly and W. B. Tuck.

"Aromatic compounds obtained from the hydroaromatic series. Part II. The action of phosphorus pentachloride on trimethyldihydroresorcin." By A. W. Crossley and J. S. Hills.

"Studies of dynamic isomerism. Part V. Isomeric sulphonic derivatives of camphor." By T. M. Lowry and E. H. Magson.

"The rusting of iron." By J. T. Nance.

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Issued 30/5/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 310.

Thursday, May 17th, 1906, at 8.30 p.m. Professor R. **Meldola**, F.R.S., President, in the Chair.

Messrs. E. Barrett, E. R. Chrystall, J. L. Foucar, P. H. Marsden, H. Martin, J. T. Nance, W. D. Seaton, W. H. Simmons, D. Sommerville, P. F. Spencer, F. W. Storey, R. W. Tonkin, and J. A. Watson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Shelton Gottlieb Agar, Panorama House, Guernsey.
Thomas William D. Gregory, 82, Moorland Road, Burslem.
John Gerard Hughes, 2, Canute Road, Southampton.
Ernest Arthur Jenkinson, Dauntsey Agricultural School, West Lavington.
William Rest Mummery, The Firs, Shenfield, Essex.
Arthur Charles Palmer, B.Sc., 17, Wansbeck Gardens, West Hartlepool.
Samuel Shrowder Pickles, B.Sc., The Imperial Institute, S.W.
Willie Macro Seaber, B.Sc., Firdale, Sheen Lane, East Sheen.
James Neil Watts, P.O. Eikenhof, Johannesburg, S. Africa.

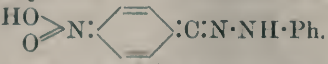
Certificates have been authorised by the Council for presentation for ballot under Bye-law I (3) in favour of:

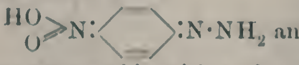
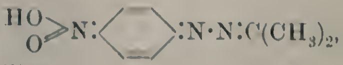
Surendra Prasad Sanyal, M.A., Majhowli Raj, Gorakhpur, U.P., India.
Allan Sime, Kingston, Jamaica.
Edward Jocelyn Wortley, Rectory, Half-way Tree, Jamaica.

Of the following papers, those marked * were read:

*98. "The relation between absorption spectra and chemical constitution. Part VI. The phenylhydrazones of simple aldehydes and ketones." By Edward Charles Cyril Baly and William Bradshaw Tuck.

A spectroscopic investigation of the phenylhydrazones of formaldehyde, acetaldehyde, propylaldehyde, acetone, and diethylketone shows that all these compounds exist in two forms, the true hydrazone and the azo-form, in which the hydrogen atom has wandered from the nitrogen atom to the carbon atom of the aldehyde or ketone residue, thus: $Ph{\cdot}NH{\cdot}N{:}CH{\cdot}CH_3$ and $Ph{\cdot}N{:}N{\cdot}CH_2{\cdot}CH_3$. The azo-form is the more stable, and all the above compounds readily pass over into this form under the influence of light, except formaldehyde phenylhydrazone, which polymerises. All the azo-compounds are strongly coloured, owing to the isorropesis between the unsaturated nitrogen atoms and the benzene nucleus. If the compounds are prepared from *p*-bromophenylhydrazine, the change to the azo-form takes place quite slowly; when aldehydes and ketones are allowed to react with *p*-bromophenylhydrazine, the true hydrazone is always produced first, which is not always the case when phenylhydrazine is used, for in certain instances the azo-compound is obtained at once. As is to be expected, true hydrazones which are perfectly stable are produced by the interaction of aldehydes and ketones with phenylmethylhydrazine.

An investigation into the absorption spectra of the hydrazones of the three isomeric nitrobenzaldehydes shows that the colour of these substances is not due to their existence in the azo-form. It is found, however, that they exist in the quinonoid form and are somewhat similar to the nitrophenols. The formula of the *para*-compound is, in all probability,  Similarly, in the case of *p*-nitrophenylhydrazine and its acetone derivative, these compounds are quinonoid, thus:

 and 

and are comparable with *p*-nitroaniline.

Discussion.

Mr. W. Robertson asked Mr. Baly if he had examined the spectra of the two pure acetaldehydephenylhydrazones individually, inasmuch as the product of melting point 80°, found by Mr. Baly to give rise to the absorption band in the ultra-violet, is far from being a pure substance. It would be of considerable interest to ascertain if this band is also shown by either isomeride in the pure state in neutral solvents.

Dr. Lander asked the authors whether the change of hydrazone to azo-compound was complete, or whether the two substances formed a mixture in equilibrium in solution.

Dr. Hewitt asked Mr. Baly if he had examined any hydrazones obtained from quinolylhydrazines. *Ortho*- and *ana*-quinolylhydrazines were examined some years back by Dufton (*Trans.*, 1891, **59**, 756; 1892, **61**, 782), when it was found that certain of the derived hydrazones, more especially those prepared with *ana*-quinolylhydrazine, exhibited brilliant colours. The author did not, however, suggest for them any other than a hydrazone structure (compare Armstrong, *Trans.*, 1892, **61**, 789).

Mr. Baly said that the two isomerides mentioned by Mr. Robertson would, if present, give identical absorption bands. He hoped to extend the work in very many directions, but had not yet examined the substances mentioned by Dr. Hewitt.

*99. "The rusting of iron." By John Trengove Nance.

It is known that ammonium chloride solution accelerates the rusting of iron. The author finds that interaction takes place with evolution of hydrogen and liberation of ammonia; iron passes into solution in the ferrous state, and is not precipitated in the absence of air, owing to the excess of ammonium chloride present.

The solubility of iron in solutions of different concentration does not diminish proportionally with the amount of ammonium chloride present; hence it is probably due to the action of hydrogen ions formed by hydrolysis of the salt, as similar proportional numbers are found for the solubility of iron and for the catalytic effect of the solutions on the hydrolysis of methyl acetate. The rate of rusting of iron in these solutions varies with the concentration in a similar manner, leading to the conclusion that rusting is due to the (mainly catalytic) action of hydrogen ions. In support of this, it is found that the chlorides of weak bases accelerate rusting far more than do those of the strong bases, and that the influence of acids is roughly proportional to their avidities.

Discussion.

Dr. Moody thought it unfortunate that chemists were not definitely agreed as to the exact meaning to be attached to the term rusting. It appeared desirable that the term should be limited to those changes which metals undergo on exposure to air under normal atmospheric conditions. With regard to the results obtained by the author of the paper under discussion, it must be borne in mind that on heating a solution of ammonium chloride at 80° ammonia would be evolved, and free hydrochloric acid would be formed in solution. In fact, the experiments resolved themselves into a determination of the attack on iron by solutions of hydrochloric acid of different strengths, and the theoretical conclusions drawn by the author appeared unwarranted.

Dr. F. M. Perkin agreed with Dr. Moody that the term rusting should be used to denote the atmospheric oxidation of iron, and should not be employed in reference to oxidation by other agencies.

He pointed out that many other metals were dissolved by ammonium salts, and asked whether Mr. Nance had tried the action of ammonium persulphate, which dissolved iron much more rapidly than other ammonium salts. The solution of the metals was evidently due to hydrolysis, and, as ferric salts are much more readily hydrolysed than ferrous salts, the explanation of the rapid solution in ammonium persulphate was to be traced to the conversion of the ferrous salt into the ferric condition. Oxidation of iron might be brought about by any feebly ionised acid. With highly ionised acids, as long as excess of acid is present, no precipitation of hydroxide will take place, but with excess of iron, hydrolysis will ultimately ensue.

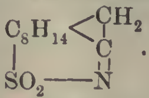
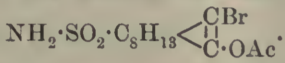
In reply, Mr. Nance said that he considered his results sufficient to prove that atmospheric corrosion and rusting of iron takes place through the catalytic intervention of hydrogen ions.

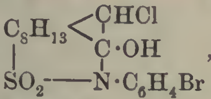
*100. "Aromatic compounds obtained from the hydroaromatic series. Part II. The action of phosphorus pentachloride on trimethyldihydroresorcin." By Arthur William Crossley and James Stuart Hills.

When phosphorus pentachloride acts on trimethyldihydroresorcin, two substances are produced, a liquid boiling at 118—119° at 33 mm., which is 3 : 5-*dichloro*-1 : 1 : 2-*trimethyl*-$\Delta^{2:4}$-*dihydrobenzene*, and a solid melting at 76·5°, namely, 3 : 5-*dichloro*-1 : 2 : 6-*trimethylbenzene*. This aromatic dichloride is converted on oxidation into 3 : 5-*dichlorohemimellitic acid*, crystallising from water in transparent, hexagonal plates, containing $2H_2O$ and melting at 226—227°, at which temperature it is rapidly converted into its *anhydride*. The *trimethyl ester* crystallises in rhombohedra melting at 62—63°, and the *monomethyl ester* melts at 141—142°.

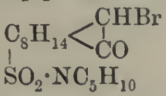
*101. "Studies of dynamic isomerism. Part V. Isomeric sulphonic derivatives of camphor." By Thomas Martin Lowry and Egbert H. Magson.

Measurements were given of the solubility of a series of twenty sulphonic derivatives of camphor, both alone and in presence of a trace of alkali. The majority of the compounds derived from α-bromocamphor and α-chlorocamphor showed an increase of solubility similar to that observed in these compounds themselves and in their β- and π-halogen derivatives (Lowry, Proc., 1906, **22**, 70).

In the case of camphor sulphonamide, a decrease of solubility resulted from the addition of alkali, and it was found that the amide, which crystallises unchanged from acetic anhydride, had been converted quantitatively by *N*/500 sodium ethoxide in alcoholic solution at 20° into the anhydramide,  $\begin{array}{lcl} C_8H_{14} & < & \begin{array}{l} CH_2 \\ \vert \\ C \end{array} \\ \vert & & \Vert \\ SO_2 & — & N \end{array}$. The π-amide derived from α-bromocamphor could not be converted into an anhydramide, but was found to yield an acetyl derivative, the solubility of which was unchanged by the addition of alkali; the compound is therefore formulated as  $NH_2{\cdot}SO_2{\cdot}C_8H_{13}<\begin{array}{l} CBr \\ \Vert \\ C{\cdot}OAc \end{array}$.

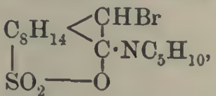
The β-sulphonanilides derived from α-bromocamphor and α-chlorocamphor dissolve readily in caustic soda and are reprecipitated by acids. Possibly on account of their acid properties, the anilides, which may be formulated as, for example,  $\begin{array}{lcl} C_8H_{13} & < & \begin{array}{l} CHCl \\ \vert \\ C{\cdot}OH \end{array} \\ \vert & & \vert \\ SO_2 & — & N{\cdot}C_6H_4Br \end{array}$, do not increase in solubility when a trace of alkali is added.

The isomerism previously observed in the camphor sulphopiperidides (Armstrong and Lowry, *Trans.*, 1902, **81**, 1449) has now been detected in the α-bromopiperidides; both compounds, formulated as



$$\begin{array}{ll} C_8H_{14} < & \begin{array}{l} CHBr \\ \vert \\ CO \end{array} \\ \vert & \\ SO_2{\cdot}NC_5H_{10} & \end{array}$$

and



$$\begin{array}{lcl} C_8H_{14} & < & \begin{array}{l} CHBr \\ \vert \\ C{\cdot}NC_5H_{10}, \end{array} \\ \vert & & \vert \\ SO_2 & — & O \end{array}$$

increase in solubility when alkali is added, and probably exist in stereoisomeric forms.

*102. "The densities of liquid nitrogen and liquid oxygen and of their mixtures." By John Kenneth Harold Inglis and Joseph Edward Coates.

The authors have determined the densities of liquid nitrogen and of liquid oxygen, and of a number of mixtures of the two liquids at the temperatures 74·70° and 79·07° Abs. on the hydrogen scale. These are the temperatures at which the vapour pressure of pure oxygen is 100 mm. and 200 mm. respectively, and they are therefore easily reproduced. The results showed that a slight contraction took place on mixing the two liquids, this contraction being greater at the higher temperature. The densities of the pure liquids differed by about 1 per cent. from the values obtained by Baly and Donnan (*Trans.*, 1902, **81**, 907). These values of the densities of the mixtures may be used to determine the relation between the partial pressures of nitrogen and oxygen above a mixture of the two liquids and their concentrations in that mixture. It is found that the solubility of nitrogen in oxygen obeys Henry's law; but that the solubility of oxygen in nitrogen does not obey the simple form of that law, for oxygen dissolved in nitrogen is associated to the extent of about 9 per cent.

103. "Glutaconic and aconitic acids."
By Harold Rogerson and Jocelyn Field Thorpe.

Ruhemann is mistaken when he states (Proc., 1906, **22**, 137) that we were not fully acquainted with his several publications dealing with these acids.

When we recorded the reactions of γ- and $\beta\gamma$-*alphyl* substituted derivatives of 2 : 6-dioxypyridine (*Trans.*, 1905, **87**, 1682), we compared them with the corresponding reactions of the *alphyl* β-substituted derivatives prepared by Ruhemann (*Trans.*, 1893, **63**, 876). The γ- and $\beta\gamma$-derivatives prepared by him (*Trans.*, 1899, **75**, 245), and which he complains have not been mentioned by us, are *aryl* derivatives containing phenyl and benzyl groups in these positions, and therefore were not, in our opinion, suitable for the purpose of comparison. As a matter of fact, the behaviour of our alphyl compounds differs in many important respects from that of the aryl compounds prepared by him.

Ruhemann has also evidently misunderstood our meaning, since he writes (*loc. cit.*) : "They state that ethyl dihydroxycinchomeronate had *first* been prepared by Errera and Perciabosco, but they overlook the fact that Ruhemann and Stapleton had obtained it the year before." The passage referred to (*Trans.*, 1906, **89**, 640) is: "It is evidently identical with the compound prepared by Errera and Perciabosco by the action of hydrochloric acid on ethyl 2 : 6-dihydroxypyridine-3 : 4 : 5-tricarboxylate." We did not desire to assign priority to Errera and Perciabosco, but merely wished to establish the identity of our compound, an object which seemed to us better attained by referring to the method of preparation adopted by these chemists, rather than to the more indirect process used by Ruhemann and Stapleton.

We have carefully re-read the paper by Ruhemann and Orton (*Ber.*, 1894, **27**, 3449), and are still of the opinion that the remark (*Trans.*, 1906, **89**, 634), "Ruhemann and Orton suggest that aconitic acid corresponds to fumaric acid in constitution, whereas the malenoid form is represented by aceconitic acid," is not an overstatement of the case, since probability surely implies suggestion.

Regarding the criticism of our formulæ for these acids and the remark that, if they were correct, then the action of ammonia on ethyl aconitate might be expected to yield a five-membered ring compound besides citrazinamide, we cannot too strongly emphasise the remarks we made in our reply to Feist and Beyer (*Trans.*, 1906, **89**, 650), which were to the effect that our formulæ for these compounds are merely an effort to represent diagrammatically a state of equilibrium between two tautomeric forms.

104. "The chemistry of organic acid 'thiocyanates' and their derivatives." By Augustus Edward Dixon.

Compounds of the class R·CO(CNS), when reacting with primary nitrogenous bases, present marked differences of behaviour, according to the nature of the hydrocarbon radicle, R. If R be aromatic, these compounds behave in ordinary circumstances principally as thiocarbimides, uniting additively with the base employed to form in each case a symmetrically disubstituted thiocarbamide: $R{\cdot}CO{\cdot}NCS + R'NH_2 = RCO{\cdot}NH{\cdot}CS{\cdot}NHR'$. On the other hand, if R be a fatty radicle, the function of the associated group, $-CO(CNS)$, varies greatly with the conditions—notably temperature and the nature of the base presented. In such cases, the end-products contain both disubstituted thiocarbamide and a mixture of substituted amide with thiocyanic acid, the latter substances originating through double decomposition: $R{\cdot}CO{\cdot}SCN + R'NH_2 = R{\cdot}CO{\cdot}NHR' + H{\cdot}SCN$.

The interposition of an oxygen atom between the radicle R and the group CO(CNS), where the former belongs to the aliphatic series, increases the thiocarbimidic power of the resultant molecule: thus, phenacetyl "thiocyanate," $Ph{\cdot}CH_2{\cdot}CO(CNS)$, and phenoxyacetyl "thiocyanate," $Ph{\cdot}O{\cdot}CH_2{\cdot}CO(CNS)$, readily yield the reaction for thiocyanic acid, whilst carbo-benzoxy-" thiocyanate," Ph·CH_2·O·CO(CNS), does so to a very trifling extent.

A number of substituted thioureas and thiocarbamides are described, resulting from the action of ammonia or other bases on various thiocarbimides, RO·CO·NCS, where R = phenyl, *o*-tolyl, *p*-tolyl, and benzyl respectively.

When acetylphenylbenzylthiourea was heated under diminished pressure, a liquid distilled over having the general properties of acetyl "thiocyanate"; this fact is regarded as confirmatory of Hawthorne's view (*Trans.*, 1906, **89**, 566) that acetylthiocyanate is identical with acetylthiocarbimide.

Phenylchlorocarbonate united directly with thiourea to form a *compound* of formula $NH:C(NH_2)\cdot S\cdot CO\cdot OPh,HCl$; on treating with dilute alkali, diphenyl carbonate and thiourea were obtained and not the corresponding base. Unlike the fatty derivatives obtained from methyl or ethyl chlorocarbonate, the hydrochloride, when decomposed by heating, did not yield a *pseudo*-thiourea, $NH:C(NH_2)\cdot S\cdot Ph$.

105. "The molybdilactate and the tungstilactate of ammonium." By George Gerald Henderson.

The observations recorded in a previous paper (*Trans.*, 1903, **83**, 259) on the influence of molybdic and tungstic anhydrides on the specific rotations of solutions of alkali *l*-lactates pointed to the conclusion that compounds of the type $RO_2(C_3H_4O_3M)_2$ are formed both when the respective anhydrides are dissolved in hot solutions of the alkali lactates and when alkali molybdates and tungstates are heated with solutions of lactic acid. Attempts have since been made to isolate the molybdi- and tungsti-lactates so produced, only one of which, namely, potassium molybdilactate, had already been obtained in crystalline form, and then in very small quantity and in a slightly impure state (*Trans.*, 1899, **75**, 554). The results were disappointing so far as the metallic salts were concerned, but, on the other hand, well-defined, stable ammonium salts of molybdilactic and tungstilactic acids were easily obtained. Thus, finally, crystalline derivatives of the tartar emetic type have been prepared from all the hydroxy-acids which were selected for examination, and in the latter case, as in the others, the author's suggestions regarding the constitution of these compounds are supported by the results of experiment.

Molybdic and tungstic anhydrides are dissolved, the latter with some difficulty, when heated on the water-bath with solutions of alkali lactates. The reaction comes to an end when the substances are present in the proportion of one mol. anhydride to two mols. lactate, and no reduction of the anhydride occurs unless a trace in excess of that amount is added, provided that the solution is not heated to boiling. Addition of alcohol to the concentrated solutions causes the separation of colourless, viscous liquids which do not become crystalline even on prolonged contact with the mother liquor. When left in a vacuum desiccator over sulphuric acid, the syrupy liquids slowly dry to amorphous, glassy masses, which are extremely deliquescent, very readily soluble in water, and fairly so in dilute alcohol. Owing to the failure of all attempts to induce these substances to crystallise, they could not be obtained in a satisfactorily purified state, but an analysis of the compound of molybdic anhydride and sodium lactate, partially purified by dissolving in a little water and precipitating with alcohol, showed that its percentage of sodium was only a little higher, and of molybdenum a little lower, than that required by the formula $MoO_2(C_3H_4O_3Na)_2$. Similar results were obtained by experiments with calcium and barium lactates. The anhydrides are dissolved fairly readily by hot solutions of these salts, but the compounds formed could not be isolated except as vitreous solids, which analysis proved to be somewhat impure.

The results were different when ammonium lactate was used. Molybdic anhydride was readily dissolved when heated on the water-bath with a solution of the salt, and, as in the case of the metallic lactates, no reduction took place unless a greater proportion of the anhydride than one mol. to two mols. lactate was added. After heating for some time, the solution was concentrated to a small bulk, and, after cooling, a quantity of a crystalline salt separated. The salt was purified by crystallisation from water, dried in a desiccator over sulphuric acid, and analysed:

1·0 gave 0·097 NH_3. $NH_3 = 9·7$.
0·5 ,, 0·235 MoS_2. $Mo = 28·2$.
$MoO_2(C_3H_4O_3NH_4)_2$ requires $NH_3 = 10·0$; $Mo = 28·2$ per cent.

Ammonium molybdilactate, $MoO_2(C_3H_4O_3NH_4)_2$, forms small, colourless crystals which are fairly readily soluble in water and insoluble in alcohol. It is stable in the dry state at the ordinary temperature, but undergoes decomposition with loss of ammonia when heated in a steam oven. It is also stable in aqueous solution, but is hydrolysed on warming with dilute alkalis or mineral acids. When silver nitrate is added to a solution of the salt, a yellow precipitate is formed which quickly turns black if exposed to light.

Ammonium tungstilactate, $WO_2(C_3H_4O_3NH_4)_2$, was prepared and purified in a similar manner. It is a colourless, crystalline salt, closely resembling and apparently isomorphous with the corresponding molybdilactate, than which it is somewhat more stable, as it does not begin to decompose when heated until a temperature of about 120° is reached, when ammonia is evolved. It dissolves in water fairly readily and without change. Analysis of the purified salt, dried at 100°, gave the following results:

0·5 gave 0·406 NH_3. $NH_3 = 8{\cdot}12$.
0·5 „ 0·268 WO_3. $W = 42{\cdot}5$.
$WO_2(C_3H_4O_3NH_4)_2$ requires $NH_3 = 7{\cdot}94$; $W = 42{\cdot}9$ per cent.

My thanks are due to Mr. Hugh B. Brown for assistance in this work.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Berkenhout, *John.* First lines of the theory and practice of philosophical chemistry. pp. xxiii + 434. London 1788. (*Recd.* 2/5/06.)
From Mr. A. W. Laurie.

British Institute of Preventive Medicine. Transactions. First series. London 1897. (*Reference.*) From the Lister Institute.

Ferguson, *John.* Bibliotheca Chemica: a catalogue of the alchemical, chemical, and pharmaceutical books in the collection of the late *James* **Young,** of Kelly and Durras, Esq., LL.D., F.R.S., F.R.S.E. 2 vols. pp. xxi + 487, 598. Glasgow 1906. (*Recd.* 24/3/06.)
From the Trustees of the late Dr. James Young.

Institute of Chemistry. Proceedings, 1878, 1879, 1881—1902. London. (*Reference.*) From the Institute.

Lister Institute of Preventive Medicine. Collected papers. No. 1. 1904. (*Reference.*) From the Institute.

Morgan, *J. Livingston R.* Physical chemistry for electrical engineers. pp. viii + 230. New York 1906. (*Recd.* 3/5/06.)
From the Publishers: Messrs. John Wiley & Sons.

University College, London. *Physiological Laboratory.* Collected papers. Vol. XIII. 1903—1905. (*Recd.* 15/3/06.)
From Professor E. H. Starling, F.R.S.

II. *By Purchase.*

Albu, *Albert,* and **Neuberg,** *Carl.* Physiologie und Pathologie des Mineralstoffwechsels nebst Tabellen über die Mineralstoffzusammensetzung der menschlichen Nahrungs- und Genussmittel sowie der Mineralbrunnen und -Bäder. pp. 247. Berlin 1906. (*Recd.* 21/3/06.)

Granger, *Albert.* La céramique industrielle. pp. x + 644. Paris 1905. (*Recd.* 16/5/06.)

Groth, *Paul Heinrich.* An introduction to chemical crystallography. Authorised translation by *Hugh* **Marshall.** pp. xii + 123. London 1906. (*Recd.* 16/5/06.)

Ingalls, *Walter Renton.* The metallurgy of zinc and cadmium. pp. xviii + 701. ill. New York 1903. (*Recd.* 24/3/06.)

König, *J.* Die Untersuchung landwirtschaftlich und gewerblich wichtiger Stoffe. 3rd Edition. pp. xxiv + 1083. ill. Berlin 1906. (*Recd.* 16/5/06.)

Mann, *Gustav.* Chemistry of the proteids. Based on *Otto* **Cohnheim's** "Chemie der Eiweisskörper." pp. xviii + 606. London 1906. (*Recd.* 21/3/06.)

Meyer, *Victor*, and **Jacobson**, *Paul.* Lehrbuch der organischen Chemie. II Auflage. I Band, I Teil, 1 Abteilung. pp. 448. Leipzig 1906. (*Recd.* 21/3/06.)

Minet, *Adolphe.* The production of aluminium and its industrial use. Translated, with additions, by *Leonard* **Waldo.** pp. vi + 266. ill. New York 1905. (*Recd.* 24/3/06.)

III. *Pamphlets.*

Bayliss, *W. M.* The kinetics of tryptic action. (Reprinted from the *Archives des sciences biologiques*, **11**, 1904.)

Bihar Planters' Association. Report of the Indigo Research Station, Sirsiah (*under subsidy from the Government of Bengal*) for the year 1905—1906. By *Cyril* **Bergtheil.** pp. 29. Calcutta 1906.

Day, *Arthur L.*, and **Shepherd**, *E. S.* Quartz glass. (From *Science*, **23**, 1906.)

Kahlenberg, *Louis.* On the nature of the process of osmosis and osmotic pressure with observations concerning dialysis. (From the *Trans. Wisconsin Acad. of Sciences*, **15**, 1906.)

Thomson, *R. T.*, and **Dunlop**, *H.* On the examination of cod-liver oil and other fish liver oils. Part II. pp. 8. Glasgow 1906.

RESEARCH FUND

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 4th, 1906.

Those Fellows who received grants in June 1905, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Friday, June 1st, 1906.

CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

EXTRA MEETINGS.

An extra meeting will be held on **Thursday**, July **5th**, at **8.30** p.m., and the new Session will begin on Thursday, October 18th.

At the next Ordinary Meeting, on **Thursday**, June **7th**, 1906, at **8.30** p.m., the following papers will be read:

"Ammonium selenate and the question of isodimorphism in the alkali series." By A. E. H. Tutton.

"An improved Beckmann apparatus for molecular weight determination." By J. M. Sanders.

"Resolution of lactic acid by morphine." By J. C. Irvine.

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Issued 16/6/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 311.

Thursday, June 7th, 1906, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. E. Feilmann and H. G. Smith were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Robert Anderson, Chester Road West, Sunderland.
Reginald William Malyon Gibbs, B.Sc., Hetty Villa, Cam Road, Chesterton, Cambridge.
Frederick James Martin, Passagem de Marianna, Minas, Brazil.
Herbert Arthur Mills, Waverley, Bloomfield Gardens, Bath.
Leonard Edward Beard Pearse, 79, Gordon Road, Ealing, W.
Thomas Ebenezer Pye, West View, Summersdale, Chichester.
Frederick John Salmon, c/o Princess Estate and Gold Mining Co., Ltd., P.O. Box 112, Roodepoort, South Africa.

Of the following papers, those marked * were read:

*106. "Ammonium selenate and the question of isodimorphism in the alkali series." By Alfred Edwin Howard Tutton.

Normal ammonium selenate crystallises differently from the seven rhombic normal sulphates and selenates of the alkalis already investigated, namely, in monoclinic prisms or tables, which are described in detail in the paper. A rhombic form of the salt was once obtained (in 1862) by von Lang, but neither Topsöe nor the author has been able to reproduce it in pure ammonium selenate. The author has obtained rhombic mixed crystals of ammonium selenate and sulphate, however, and concludes that ammonium selenate is dimorphous, and that the whole series of sulphates and selenates is probably isodimorphous, as has been shown to be the case with other series of the salts of ammonium, potassium, rubidium, and cæsium.

The original crystals investigated by Prof. von Lang have been kindly sent by him to the author, who finds that the majority are truly rhombic, but that they are somewhat impure, containing admixed sulphate, which is probably the reason for their production, for they closely resemble the author's mixed crystals, although much richer in selenate. Besides the rhombic crystals, however, some needles were found of nearly pure ammonium selenate, which are identical with the author's monoclinic form.

The monoclinic crystals of ammonium selenate show a pseudo-hexagonal primary prism zone very similar to that of the rhombic crystals of the other salts, and the topic parameters calculated on this analogous mode of description show a mean value for the structural dimensions intermediate between the mean values for rubidium and cæsium selenates. The molecular volume, refractive indices, dimensions of the optical ellipsoid, and the molecular optical constants are singularly near what would have been expected if the crystals had been truly isomorphically rhombic, and unite in exhibiting ammonium selenate in its proper position in the series immediately after rubidium selenate, precisely analogous to the position of ammonium sulphate in the sulphate series, and which the author has shown is the general position of ammonium crystallographically in the alkali series.

As a side issue, a general explanation has been arrived at for the beautiful optical property of crossed-axial-plane dispersion of the optic axes, ammonium selenate forming the fifth case of this somewhat rare phenomenon which has been met with in the alkali series.

*107. "The vapour pressures of binary mixtures. Part I. The possible types of vapour pressure curves." By Arthur Marshall.

The curves showing the variations of partial pressures with molecular composition may be classified into four types, of which three relate to substances which are miscible in all proportions, and are distinguished one from the other according as p/x, the partial pressure divided by the molecular proportion, is less than, equal to, or greater than the vapour pressure of the pure substance. The corresponding total pressure curves are obtained by adding together the two partial pressure curves, which are of the same type. By differentiating the equation of Duhem and Margules, $x d \log p_1 + (1-x) d \log p_2 = o$, it has been found possible to classify the total pressure curves into twelve types, all of which are known to occur.

It may be proved that with pairs of substances which are miscible in all proportions only one maximum or minimum can occur in the curve of total pressure. The rule, called by Duhem "Regnault's Law," that in the case of partially miscible liquids the total pressure of the heterogeneous mixture is equal to the vapour pressure of the more volatile constituent in the pure state, has been shown experimentally to be approximately true for methyl acetate and water as well as for ether and water, but it is only a rough approximation and is applicable only to some cases.

The vapour pressures of the following pairs of liquids have been investigated experimentally: nitroglycerol and acetone, diethylamine and acetone, ethyl alcohol and methyl ethyl ketone, water and methyl ethyl ketone, water and methyl acetate, water and ether, water and amyl alcohol. From the curve of total vapour pressures, the partial pressures may be obtained by a simple graphical method.

*108. "The behaviour of acetylene with electrical discharges of high frequency." By Herbert Jackson and Dudley Northall Laurie.

The authors have studied the change, observed by one of them some years ago, when acetylene is subjected to discharges from an ordinary high-frequency apparatus. A semi-solid, brown substance is formed, which sets to a hard and very insoluble solid on exposure to air. If care be taken to avoid secondary reactions by too prolonged a passage of the discharge, the composition of the solid agrees with that of acetylene, and is apparently a polymeride. The substance absorbs oxygen readily up to about 8 per cent. When heated out of contact with air, an oil distils and a small quantity of gas is evolved, which consists mainly of methane and hydrogen. The authors are proceeding with the examination of the reactions of the substance, which exhibits many curious properties.

*109. "The behaviour of the vapours of methyl alcohol and acetaldehyde with electrical discharges of high frequency."

By Herbert Jackson and Dudley Northall Laurie.

The authors have examined the reactions as part of a series of experiments conducted with a view to determining the nature and order of change effected by high-frequency discharges when passed through various gases and vapours. Working with discharges of very short duration, they find the first change in the vapour of methyl alcohol to be the formation of carbon monoxide and hydrogen; in the case of acetaldehyde, the greater part of the vapour breaks up into methane and carbon monoxide, but acetylene and water are also produced simultaneously, though in smaller quantities. Both these changes are reversible, the latter more readily than the former. The authors have continued experiments conducted by one of them some time ago on a number of saturated and unsaturated compounds, and they have come to the conclusion that in the case of paraffin derivatives the general tendency is for unsaturated bodies to give polymeric varieties under the influence of high-frequency discharges, whilst saturated compounds, under similar conditions, yield substances of simpler structure.

Discussion.

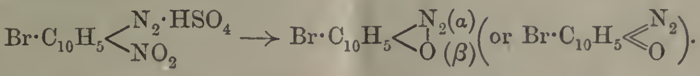
In reply to the President: Prof. Jackson said that after trying acetylene made from varying sources, purified acetylene made from calcium carbide and a saturated solution of sodium carbonate was used. The gas was dried over phosphorus pentoxide. No process which could be considered as likely to depolymerise the product gave any acetylene.

In reply to Dr. M. O. Forster: Prof. Jackson called attention to the marked activity of the oxidised product obtained after exposing the tacky substance freely to air, and stated that the usual methods for examining for activity in the combined oxygen gave no positive results.

110. "Note on 4-bromo-2-nitro-1(α)-naphthylamine."

By Raphael Meldola and Hugh Gordon Dale.

It was shown some years ago by one of the authors and C. H. Desch (*Trans.*, 1892, 61, 765) that the above compound could be diazotised under the usual conditions with the formation of diazonium salts which were stable in the presence of excess of sulphuric acid and in cooled solutions. In repeating the diazotisation of the base for another purpose, the authors have found that if the solution of the diazonium sulphate is diluted with water and warmed, an immediate decomposition takes place with the elimination of the nitro-group and the formation of a diazo-oxide :



$$\mathrm{Br{\cdot}C_{10}H_5}<\begin{matrix}\mathrm{N_2{\cdot}HSO_4}\\ \mathrm{NO_2}\end{matrix} \longrightarrow \mathrm{Br{\cdot}C_{10}H_5}<\begin{matrix}\mathrm{N_2}(\alpha)\\ | \\ \mathrm{O}\ (\beta)\end{matrix}\left(\text{or } \mathrm{Br{\cdot}C_{10}H_5}\ll\begin{matrix}\mathrm{N_2}\\ \mathrm{O}\end{matrix}\right).$$

This compound is therefore isomeric with the diazo-oxide described by one of the authors and F. W. Streatfeild in 1895 (*Trans.*, 67 907), and is identical with the compound more recently described by K. J. P. Orton (*Proc.*, 1902, 17, 253), with which it agrees in melting point (132°) and other properties.

0·0759 gave 7·3 c.c. moist nitrogen at 11° and 765 mm. N = 11·46.

$\mathrm{C_{10}H_5ON_2Br}$ requires N = 11·25 per cent.

The chief point of interest attaching to the present mode of formation of the compound is that it is produced by the elimination of the β-nitro-group, instead of by the displacement of the β-halogen atom, as in Orton's process.

The diazo-oxide on boiling with cuprous chloride solution is converted into 1-chloro-4-bromo-2(β)-naphthol, which crystallises from dilute alcohol in white needles melting at 112° and becoming yellowish-brown on exposure to the air.

0·0851 gave 0·1022 AgCl + AgBr.

$\mathrm{C_{10}H_6OClBr}$ requires 0·1026 AgCl + AgBr.

Special interest attaches to this chlorobromonaphthol in connection with the replaceability of the second $\beta(=3)$-hydrogen atom, from which point of view the compound may be worth detailed study. Attempts to prepare the 1-chloro-4-bromo-2 : 3-naphthaquinone have so far led to negative results, but the experiments will be repeated under different conditions.

111. "Dinitroanisidines and their products of diazotisation (second communication)." By Raphael Meldola and Frank George C. Stephens.

By the nitration of diacetyl-*m*-aminophenol, the authors have obtained a mixture of two isomeric mononitroacetaminophenols, which, on hydrolysis, yield respectively 4-nitro-3-aminophenol (m. p. 185—186°) and 6-nitro-3-aminophenol (m. p. 158°). The nitroacetaminophenols on nitration both yield the same dinitro-derivative, 4 : 6-dinitro-3-acetaminophenol (m. p. 168°), and this hydrolyses to 4 : 6-dinitro-3-aminophenol. The latter crystallises in dull orange needles of m. p. 231°. The methyl ether (= 4 : 6-dinitro-*m*-anisidine) obtained by direct methylation, or, more advantageously, by the direct nitration of *m*-acetaminophenol methyl ether, crystallises in small, canary-yellow needles of m. p. 208° (acetyl derivative, m. p. 146°). This dinitro-*m*-anisidine does not lose a nitro- or methyl-group on diazotisation, but forms diazonium salts of the ordinary type. From this, combined with former results, the authors conclude that the conditions essential for the elimination of a nitro-group on diazotisation are that there should be a nitro-group, ortho- or para- with respect to the diazonium group, and that this displaceable nitro-group should have a similar group (or possibly a halogen atom) in the ortho-position with respect to itself. Experiments with other dinitro- and haloid-nitroanisidines are in progress.

112. "The action of sulphur dioxide and aluminium chloride on aromatic compounds." By Samuel Smiles and Robert Le Rossignol.

The authors have previously shown (*Trans.*, 1906, **89**, 696) that thionyl chloride reacts with phenetole in the presence of aluminium chloride, giving rise successively to a sulphoxide and a sulphonium base; it has since been found that this reaction may be brought about by sulphur dioxide with the aid of the same condensing agent. An examination of the behaviour of various phenolic ethers towards these reagents has shown that the products of the reaction vary according to the nature and position of the substituents in the aromatic nucleus, and in some cases it has been possible to isolate the primary product, the sulphinic acid, in considerable quantity. Preliminary experiments have indicated that the aromatic hydrocarbons are attacked in a similar manner.

113. "Action of sodium on *αα*-dichloropropylene." By Ida Smedley.

Van Romburgh and van Dorssen have shown (*Proc. K. Acad. Wetensch. Amsterdam*, 1905, **8**, 565) that the simplest hexatriene, $CH_2\colon CH\cdot CH\colon CH\cdot CH\colon CH_2$, may be synthesised by heating the diformate of *s*-divinyl glycol.

During the past year, the author has endeavoured to prepare a series of hexatrienes from *αα*-dichloropropylene and its homologues. A preliminary account of these experiments is now put forward.

Hübner and Genther state that *αα*-dichloropropylene is indifferent to sodium (*Annalen*, 1860, **114**, 36). The author finds that if a solution of this substance in petroleum (b. p. 100—110°) is heated with potassium or sodium on a water-bath at about 80° during several days and the petroleum solution separated and fractionally distilled, a small amount of a liquid boiling at 60° and a still smaller quantity of a fraction boiling at about 80° can be isolated. A relatively large proportion of a brown, amorphous solid, insoluble in petroleum or water, is also formed in this reaction.

The fraction boiling at 60° gave the following results on analysis :

$C = 87{\cdot}0$; $H = 11{\cdot}85$.

C_6H_{10} requires $C = 87{\cdot}81$; $H = 12{\cdot}19$ per cent.

Vapour density found 44, calculated 41.

It united readily with bromine, forming a white, solid tetrabromide melting at 51° and containing 80·02 per cent. of bromine. The liquid was therefore diallyl.

The amount of the fraction boiling from 80° to 83° was insufficient for identification ; it was probably the hexatriene now isolated by van Romburgh and van Dorssen.

The method is being applied for the reduction of $\alpha\alpha$-dichloro-γ-phenylpropylene and of $\alpha\alpha$-dichloro-γ-methylpropylene ; the substances obtained in these experiments are at present under examination.

114. "Resolution of lactic acid by morphine."

By James Colquhoun Irvine.

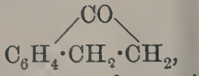
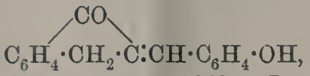
Fermentation lactic acid may be readily resolved into its active components by the crystallisation of the morphine salts. On neutralising an aqueous solution of the inactive acid with the alkaloid, the sparingly soluble morphine *l*-lactate separated almost quantitatively, whilst the compound with the *d*-acid remained in solution. The crystalline morphine salt was converted into zinc *l*-lactate, which gave $[\alpha]_D^{20^\circ}$ +6·84° and a more accurate test of the purity of the active acid was obtained by its conversion by means of the silver oxide reaction into methylic *l*-methoxypropionate, which showed $[\alpha]_D^{20^\circ}$ +94·7°.

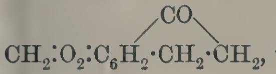
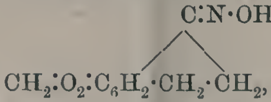
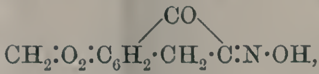
The latter compound was reduced by hydriodic acid to *l*-lactic acid, a reaction which shows that silver oxide does not affect the configuration of an active lactate.

By decomposing the syrup containing the soluble morphine *d*-lactate, more than 50 per cent. of the theoretical yield of the active zinc salt ($[\alpha]_D^{2}$ −6·83°) was obtained.

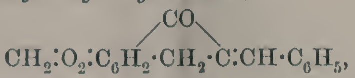
115. "Brazilin and hæmatoxylin. Part VIII." By William Henry Perkin, jun., and Robert Robinson.

The following synthetical experiments have been commenced with the object of obtaining additional evidence as to the constitution of brazilin and hæmatoxylin.

a-Hydrindone,  $\overset{CO}{C_6H_4{\cdot}CH_2{\cdot}CH_2}$, condenses readily with salicylaldehyde in the presence of caustic potash, and is converted into *salical-a-hydrindone*,  $\overset{CO}{C_6H_4{\cdot}CH_2{\cdot}C{:}CH{\cdot}C_6H_4{\cdot}OH}$, which crystallises in yellow needles and decomposes at 206°. It yields a brilliant red potassium derivative, but does not appear to combine with hydrogen chloride.

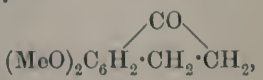
When methylenedihydrocaffeic acid, $CH_2{:}O_2{:}C_6H_3{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$, is treated with phosphorus pentachloride and then with aluminium chloride (compare Kipping, *Trans.*, 1894, 65, 484), it is converted into *methylenedihydroxy-a-hydrindone*,  $\overset{CO}{CH_2{:}O_2{:}C_6H_2{\cdot}CH_2{\cdot}CH_2}$, which melts at 160°. The *oxime*,  $\overset{C{:}N{\cdot}OH}{CH_2{:}O_2{:}C_6H_2{\cdot}CH_2{\cdot}CH_2}$, obtained by the action of hydroxylamine hydrochloride and caustic potash in the usual manner, melts at 246° with decomposition. iso*Nitrosomethylenedihydroxy-a-hydrindone*,  $\overset{CO}{CH_2{:}O_2{:}C_6H_2{\cdot}CH_2{\cdot}C{:}N{\cdot}OH}$, is formed when an alcoholic solution of methylenedihydroxy-*a*-hydrindone is mixed with *iso*amyl nitrite and hydrochloric acid. It crystallises in yellow needles, decomposes at 230°, and when treated first with phosphorus pentachloride and then with caustic potash, yields *methylenedihydroxyhomophthalic acid*, $CH_2{:}O_2{:}C_6H_2(CO_2H)CH_2{\cdot}CO_2H$, which crystallises from water and melts at about 236°.

Benzalmethylenedihydroxy-a-hydrindone,



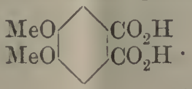
$$\overset{CO}{CH_2{:}O_2{:}C_6H_2{\cdot}CH_2{\cdot}C{:}CH{\cdot}C_6H_5},$$

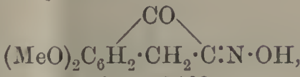
is produced when methylenedihydroxy-*a*-hydrindone is treated with benzaldehyde and alcoholic potash, and crystallises in pale yellow needles which decompose at about 250°.

4 : 5-*Dimethoxy-a-hydrindone* (1 : 2),  $\overset{CO}{(MeO)_2C_6H_2{\cdot}CH_2{\cdot}CH_2}$, is obtained when dimethyldihydrocaffeic acid,

$$(MeO)_2{\cdot}C_6H_3{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H,$$

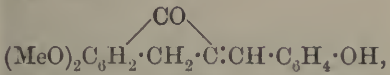
is treated with phosphorus pentachloride and then with aluminium chloride. It crystallises from benzene, melts at 114°, and, when oxidised with nitric acid, yields *m*-hemipinic acid,





$$\mathrm{(MeO)_2C_6H_2}\overset{\mathrm{CO}}{\mathrm{\cdot CH_2\cdot C}}\mathrm{{:}N\cdot OH}$$

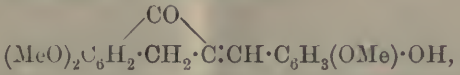
The iso*nitroso*-derivative, $\mathrm{(MeO)_2C_6H_2 \cdot CH_2 \cdot C{:}N \cdot OH}$, crystallises in yellow needles which decompose at about 240°.



$$\mathrm{(MeO)_2C_6H_2}\overset{\mathrm{CO}}{\mathrm{\cdot CH_2\cdot C}}\mathrm{{:}CH\cdot C_6H_4\cdot OH}$$

Salicaldimethoxy-a-hydrindone, $\mathrm{(MeO)_2C_6H_2 \cdot CH_2 \cdot C{:}CH \cdot C_6H_4 \cdot OH}$, is produced when dimethoxy-α-hydrindone is treated, in alcoholic solution, with salicylaldehyde and caustic potash. It crystallises in yellow needles, yields a brick-red hydrochloride, and a brilliant red, crystalline potassium derivative.

p-*Methoxysalicaldimethoxy-a-hydrindone*,



$$\mathrm{(MeO)_2C_6H_2}\overset{\mathrm{CO}}{\mathrm{\cdot CH_2\cdot C}}\mathrm{{:}CH\cdot C_6H_3(OMe)\cdot OH},$$

is of special interest on account of the close relationship which it bears to trimethylbrazilin. It is obtained when dimethoxy-α-hydrindone is treated with *p*-methoxysalicylaldehyde and caustic potash in alcoholic solution, and crystallises from *iso*amylic alcohol in prisms which decompose at about 230°. It yields a golden-yellow potassium derivative and a crimson hydrochloride.

The authors are engaged in the further investigation of the above and other analogous substances.

116. "A study of the reaction between hydrogen peroxide and potassium persulphate." By John Albert Newton Friend.

It is shown that solutions of hydrogen peroxide and potassium persulphate interact according to the equation $H_2O_2 + K_2S_2O_8 = 2KHSO_4 + O_2$. The reaction, however, is monomolecular. This is due to the formation of an intermediate and highly unstable compound, directions for the preparation of which are given. Sulphuric acid is found to exert a retarding influence on the reaction, as do the sulphates of sodium, potassium, and manganese, the last-named accelerating slightly as the reaction nears completion. The action of colloidal platinum has also been studied.

117. "The action of magnesium methyl iodide on dextro-limonene nitrosochlorides." By William Augustus Tilden and Frederick George Shepheard.

The α- and β-nitrosochlorides were treated separately, but yielded similar products differing only in melting point and degree of optical activity. The compound formed in each case differs in composition from the nitrosochloride by one atom of oxygen, and therefore has the formula $C_{20}H_{32}ON_2Cl_2$. It is insoluble in aqueous alkalis and in acids, though easily soluble in the usual organic solvents. Alcoholic potash removes the elements of hydrogen chloride, but the resulting oil rapidly changes in contact with the air. No definite derivatives could be obtained by the use of any reagent except phosphorus pentachloride, which replaces the remaining atom of oxygen by two atoms of chlorine. The product, $C_{20}H_{32}N_2Cl_4$, is optically active and readily loses two molecules of hydrogen chloride, yielding the compound $C_{20}H_{30}N_2Cl_2$, which is also optically active and saturated. The product of the action of phosphorus pentachloride does not react as a nitrogen chloride.

118. "Electrolysis of potassium ethyl dipropyl malonate." By David Cowan Crichton.

A concentrated aqueous solution of potassium ethyldipropylmalonate yields on electrolysis the ethyl esters of *α-propyl-β-ethylacrylic acid*, *dipropylglycollic acid*, *tetrapropylsuccinic acid*, and probably *dipropylacetic acid*.

The dipropylglycollic acid obtained in the electrolysis was proved to be identical with the "dipropyloxalic acid" of Rafalsky.

Tetrapropylsuccinic acid yields an anhydride which is characterised by the same stability towards alkalis as tetraethylsuccinic anhydride.

119. "A new method for the measurement of hydrolysis in aqueous solution, based upon the consideration of the motion of ions." By Robert Beckett Denison and Bertram Dillon Steele.

The authors have previously described a method for the direct determination of transport numbers and ionic velocities which necessitates the employment of an auxiliary or indicator solution. This indicator must not be hydrolysed if accurate results are to be obtained, since hydrolysis causes the production of new ions which have an effect on the apparent velocity of the ion which is being subjected to measurement. Thus, if lithium chloride is used as an indicator for potassium chloride, correct numbers for the velocity of the K˙ ion are obtained, since lithium chloride is not hydrolysed in solution. If, however, a salt of the nature of aniline hydrochloride is used as indicator, the H˙ ions which are produced as the result of hydrolysis cause a false value to be obtained for the velocity of the K˙ ion. The difference between the real and apparent velocities of the K˙ ion is dependent on the degree of hydrolysis of the indicator, and it has been found possible, by means of a study of the motion of the different ions in the system, to deduce a formula which gives values for the degree of hydrolysis in the indicator solution well in accordance with the numbers commonly accepted as correct. The only measurements which have to be made are three conductivity determinations. Measurements have been carried out with three salts, namely, the hydrochlorides of aniline, *ortho*- and *para*-toluidine at 18° and 25°. The values obtained for the "hydrolysis constants" are:

	Aniline hydrochloride.	*o*-Toluidine hydrochloride.	*p*-Toluidine hydrochloride.
At 18°	$61{\cdot}9 \times 10^3$	$46{\cdot}0 \times 10^3$	256×10^3
,, 25°	$43{\cdot}6 \times 10^3$	$29{\cdot}6 \times 10^3$	186×10^3

This gives for the "dissociation constants" of the respective bases (assuming for water $H^{\cdot} \times OH' = 1{\cdot}2 \times 10^{-14}$) at 25°:

Aniline $= 5{\cdot}2 \times 10^{-10}$
o-Toluidine $= 3{\cdot}5 \times 10^{-10}$
p-Toluidine $= 22 \times 10^{-10}$

From the values obtained for the "hydrolysis constants" of the hydrochlorides at 18° and 25°, the heat of hydrolysis was calculated by the application of van't Hoff's equation. The results were in fair agreement with the values obtained calorimetrically, the numbers being as follows:

Aniline hydrochloride	 8700	cals.
o-Toluidine ,,	11000	,,
p-Toluidine ,,	 7900	,,

120. "The oxidation of hydrocarbons by ozone at low temperatures."

By Julien Drugman.

Experimental proof is given that the mode of action of ozone on a saturated and an unsaturated hydrocarbon is very different.

Ozone acts, at the ordinary temperature, very slowly on saturated hydrocarbons such as methane and ethane. The process is one of gradual hydroxylation. In the case of ethane, ethyl alcohol is shown to be the first product formed.

The reaction in the case of an unsaturated hydrocarbon such as ethylene is instantaneous, even at temperatures far below 0°.

A very explosive addition compound is first formed, which decomposes extremely readily, giving oxidation products containing only one carbon atom. The carbon chain is broken at the double bond.

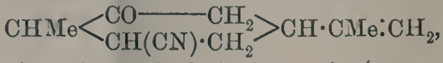
Comparison with the results of Harries' work make it probable that the addition product is an ozonide, but the decomposition of this is more complex than that usually obtained with a liquid or solid ozonide. The following equations probably represent the process :

$$(1)\ C_2H_4 + O_3 = C_2H_4O_3 = \begin{cases} (a)\ CH_2O + HCO_2H \\ (b)\ CH_2O + CO + H_2O \end{cases}.$$

$$(2)\ C_2H_4O_3 + H_2O = 2CH_2O + H_2O_2.$$

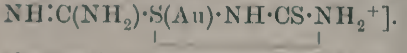
Formaldehyde, formic acid, carbon monoxide, hydrogen peroxide, and water are obtained.

121. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part V. Cyanodihydrocarvone." By Arthur Lapworth.

The nitrile formed when carvone unites with one molecular proportion of hydrogen cyanide (Hann and Lapworth, *Proc.*, 1904, **20**, 54) is cyanodihydrocarvone,  $CHMe{<}\begin{matrix}CO\text{———}CH_2\\CH(CN)\cdot CH_2\end{matrix}{>}CH\cdot CMe{:}CH_2$, and the two acids to which it gives rise on hydrolysis are the corresponding stereoisomeric carboxylic acids. Evidence of the occurrence of reversible dynamic isomerism in the nitrile and the two acids has been obtained.

The properties of these compounds and of a number of their derivatives are described.

122. "Thiocarbamide as a solvent for gold." By James Moir.

Two new complex gold-salts have been obtained by dissolving gold in an acid solution of thiocarbamide (*Proc.*, 1906, **22**, 105). They approximate in composition to $Au_2SO_4 + 6CH_4N_2S$ and $AuCl + 2\frac{2}{3}CH_4N_2S$ respectively, but the author considers that the correct formulæ are $C_6H_{20}N_{12}S_6Au_2(SO_4)$ and $C_8H_{26}N_{16}S_8Au_3Cl_3$ respectively, and that both contain a complex cation $C_2H_6N_4S_2\overset{+}{Au}$ [most probably  $NH{:}C(NH_2)\cdot\underline{S(Au)\cdot NH\cdot CS\cdot N}H_2{}^{+}$]. The author suggests that the abnormal cuprous-thiocarbamide salts have similar constitutions.

The chloride has been studied in some detail. It is converted into the compound described by Reynolds, $C_2H_8N_4S_2AuCl$, by boiling with hydrochloric acid. Its formation from aurichloride and thiocarbamide takes place according to the equation: $3AuCl_3 + 8CH_4N_2S = C_8H_{26}N_{16}S_8Au_3Cl_3 + 6HCl$.

On warming with sodium hydrate solution, it gives the olive-green gold compound described by B. Rathke (*Ber.*, 1884, **17**, 307), which the present author formulates as $CH_3N_2S_2Au_3$; the filtrate contains chloride and sulphide of sodium. On heating to 210° until constant, the brown residue appears to have the composition $Au_3S_2 \cdot 3CH_4N_2S$.

Silver nitrate gives a mixture of silver chloride, auric hydrate, and silver thiocarbamide in the proportions required by the formula assigned to the original substance.

Substituted thiocarbamides have no action on gold.

123. "An improved Beckmann apparatus for molecular weight determinations." By James McConnell Sanders.

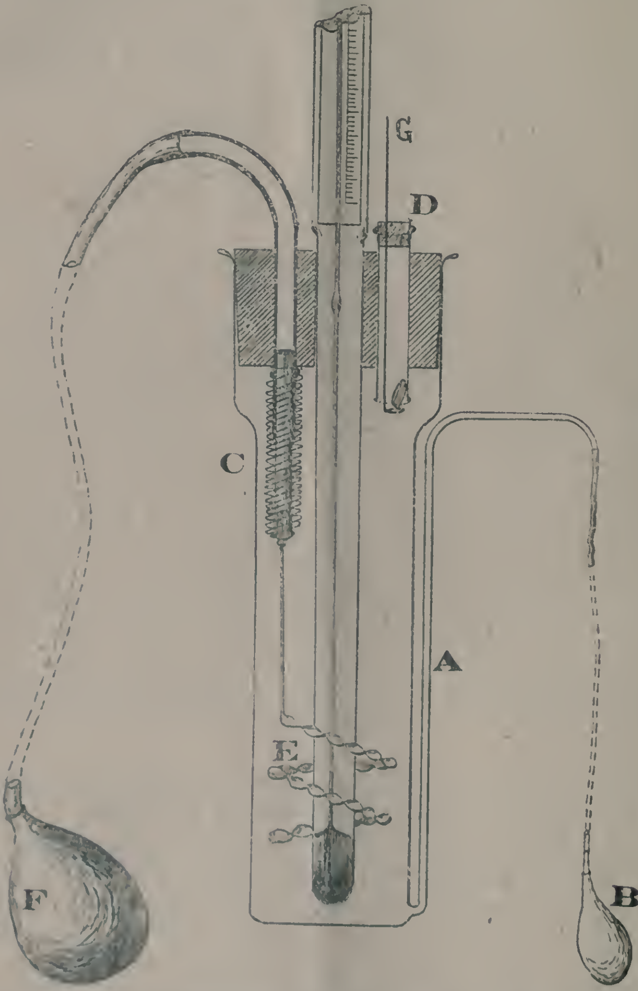
In the determination of molecular weights by the freezing-point method, employing the Beckmann apparatus as usually constructed, several sources of error have to be contended with, some of which depend on the form of the apparatus, and are considerably augmented when hygroscopic solvents such as acetic acid are used.

One of the chief difficulties is to equalise the overcooling for parallel observations with the solvent and solution, and it is not always easy to add the ice crystals which induce congelation at correspondingly equal temperature intervals from the freezing point. With the little contrivance ("Impfstift") recommended by Beckmann for this purpose, several errors are liable to be introduced; an unknown, or at least a variable, addition to the weight of the solvent is made, the ice crystals absorb moisture during their transference, and during the time that the side tube is open, moisture is absorbed by the solvent in the tube.

Moreover, when the temperature of the surrounding atmosphere is but a few degrees above the freezing point of the solvent, it is difficult to ensure the addition of the crystals to the solvent or solution at the precise moment when they are required. Another source of error exists in the introduction of moist atmospheric air by the action of the stirrer.

The author has succeeded in eliminating these errors by the use of the modified form of inner tube described in this paper.

The principal feature of the new inner tube consists in the use of the narrow, almost capillary side-tube, *A*, which is fused into the bottom of the solution tube, and is carried up and bent so as to permit the attachment of a thin rubber tube and small bulb, *B*. When the solvent has been placed in the containing tube, the height of the column of liquid in *A* can easily be adjusted by first expelling it completely by compression of *B*, then pinching the rubber tube while *B* is removed, allowed to fill itself with air, and replaced. On releasing the rubber tube, a small amount of the solvent rises in *A*, and the height of the column subsequently increases owing to the contraction of the air in the tube produced by the cooling. The container tube is placed in a wide jacket tube (not shown in the figure) in such a way that the side-tube, *A*, is in contact with the walls of the latter ; a better arrangement is to employ a tube with a lateral canal such as is provided in some hydrometer cylinders.



In operation, the column of solvent in *A*, being nearer to the source of cold, freezes first, and at the moment desired a mass of crystals can be projected into the main body of the solvent by a sharp compression of the bulb, *B*.

The pneumatic stirrer, *C*, is almost self-explanatory; it is an adaptation of the well-known pneumatic "shutter release," found on the majority of photographic cameras. The piston and cylinder are of aluminium or glass ground to fit perfectly (in the author's laboratory use was made of a glass hypodermic syringe of small diameter), the agitator, *E*, is made by flattening a portion of the length of a piece of platinum wire, and then twisting the flattened portion in the manner shown; the twisted part is coiled into a spiral form, and the other end of the wire fixed to the end of the plunger or piston. The spring which balances the weight of the agitator is made of hard drawn aluminium or platino-iridium wire, sufficient length being given to it to allow of a somewhat extended "stroke."

One of the conveniences attending this arrangement lies in the fact that both stirrer and "crystallisation inducer" can be easily operated without the fatigue attendant on the use of the ordinary form; the operator's hands rest on the table, and he can conveniently observe the thermometer without his attention being distracted by manipulative details.

The ordinary side-tube of the Beckmann apparatus is replaced by the small vertical tube, *D*, which passes through a third perforation in the rubber stopper. The introduction of the substance can be accomplished by the momentary removal of the stopper of *D*, or if it should be desired to avoid all possibility of the entrance of atmospheric air, the substance in the form of a compressed tablet can be previously placed in *D* and sustained by a bent wire, *G*, a half revolution of the latter allowing the tablet to drop into the solvent at the desired moment.

The apparatus can easily be constructed by anyone accustomed to glass working, or it can be adapted from a small Soxhlet extraction tube by cutting off the upper and lower parts and the wide side tube and bending the narrow syphon tube into the form of *A*.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Electrochemical Society. Transactions. Vols. IV—VII. Philadelphia 1903—1905. (*Reference*). From Dr. F. Mollwo Perkin.

Hollard, *A.*, and **Bertiaux,** *L.* Analyse des métaux par électrolyse. pp. xi + 180 + iv. Paris 1906. (*Recd.* 28/5/06.)
From the Publishers: Messrs. H. Dunod and E. Pinat.

Loeb, *Jacques.* The dynamics of living matter. pp. xi + 233. New York 1906. (*Recd.* 28/5/06.)
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Prantl, *Wilhelm.* Die Literatur des Vanadins, 1804—1905. pp. 117. Hamburg und Leipzig, 1906. (*Recd.* 28/5/06.)
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II. *By Purchase.*

Blount, *Bertram.* Practical electro-chemistry. 2nd Edition. pp. xi + 394. ill. London 1906. (*Recd.* 18/5/06.)

Leffmann, *Henry*, and **Beam,** *William.* Select methods of food analysis. 2nd Edition. pp. vi + 396. ill. 1905. (*Recd.* 22/5/06.)

CLEVE MEMORIAL LECTURE.

The Cleve Memorial Lecture will be delivered by Professor T. E. Thorpe, C.B., F.R.S., on Thursday, June 21st, 1906, at 8.30 p.m., before the business of the Ordinary Meeting.

EXTRA MEETINGS.

An extra meeting will be held on **Thursday**, July **5th**, at **8.30** p.m., and the new Session will begin on Thursday, October 18th.

At the next Ordinary Meeting, on **Thursday**, June **21**st, 1906, at **8.30** p.m., the following papers will be communicated, after the delivery of the Cleve Memorial Lecture:

"The constituents of the essential oil from the fruit of *Pittosporum undulatum.*" By F. B. Power and F. Tutin.

"Mobility of substituents in derivatives of β-naphthol." By J. T. Hewitt and H. V. Mitchell.

R. CLAY AND SONS, LIMITED, BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/6/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 312.

Thursday, June 21st, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Professor T. E. THORPE, F.R.S., delivered the Cleve Memorial Lecture. A vote of thanks to the lecturer was proposed by Sir Henry E. Roscoe, seconded by Professor Tilden, and carried by acclamation.

The PRESIDENT announced that the Council had awarded the Longstaff medal to Professor W. N. Hartley, F.R.S., in recognition of his spectrochemical investigations; the presentation will be made at the first meeting of the new session, Thursday, October 18th, at 8.30 p.m.

Messrs. H. G. F. Micklewright and J. S. Hills were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Samuel Field, 53, Whitburn Road, Lewisham, S.E.
Frederick James Harris, 1, Alexandra Terrace, Bath Road, Exeter.
Archibald McArthur Johnston, Box 108, Germiston, Transvaal, South Africa.
Emmanuel Isaac Thorne, 13, Cantwell Road, Plumstead, S.E.
Frederick William Watson, B.Sc., P.O. Box 108, Germiston, Transvaal, South Africa.

A certificate has been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of :

Dr. Charles H. Hertz, Chapel Hill, North Carolina, U.S.A.

Of the following papers, those marked * were read :

*124. "The constituents of the essential oil from the fruit of *Pittosporum undulatum*." By Frederick Belding Power and Frank Tutin.

The oil employed in this investigation was freshly distilled for the purpose in Australia. From 220 kilograms of the nearly ripe fruit, gathered during December and January, 960 grams of oil were obtained, corresponding to a yield of 0·44 per cent. The essential oil is pale yellow, and has a pleasant odour resembling that of orange oil. Its constants were as follows: $d 15^\circ/15^\circ = 0{\cdot}8615$; $\alpha_D + 74^\circ 4'$ in a 1-dcm. tube. It was insoluble in ten times its volume of 70 per cent. alcohol.

The results of the investigation have shown that Pittosporum oil contains the following substances: *d*-pinene (nitrosochloride; nitrolbenzylamine, m. p. 123°), about 4 per cent.; *d*-limonene (tetrabromide, m. p. 104°), about 75 per cent.; esters of valeric, formic, and other acids, a small amount; an optically inactive *sesquiterpene* (b. p. 263—264°, corr.; $d 15^\circ/15^\circ = 0{\cdot}9100$; $n_D^{20^\circ} = 1{\cdot}5030$; molecular refraction, 66·22), about 15 per cent.; palmitic acid and an undetermined phenol in very small amount, and apparently a trace of salicylic acid.

The sesquiterpene contained in this oil is a slightly viscid liquid, having a pale straw colour and a delicate rose-like fragrance. Although it was not possible to obtain from it any solid derivative, such as the hydrochloride, nitrosochloride, nitrosite, or nitrosate, and thereby definitely characterise it, it is evidently not identical with either of the previously known optically inactive sesquiterpenes, humulene and limene (*Trans.*, 1895, **67**, 60, 780, and 1904, **85**, 416), and may therefore be regarded as a compound which has not hitherto been described. Its molecular refraction indicates that it belongs to the group of dicyclic sesquiterpenes with two ethylenic linkings.

*125. "Mobility of substituents in derivatives of β-naphthol." By John Theodore Hewitt and Herbert Victor Mitchell.

The authors found that when *p*-nitrobenzenediazonium chloride was added to an alkaline solution of 1-bromo-2-naphthol, coupling immediately occurred. The resulting substance when purified was free from halogen, and on analysis proved to be identical with *p*-nitrobenzeneazo-*β*-naphthol; the bromine atom had consequently been displaced by the benzene group. The generality of the reaction was shown by examining the behaviour of the corresponding chloro- and iodo-*β*-naphthols, whilst alkaline bromonaphthol was also treated with diazotised solutions of the following amino-compounds: *o*-, *m*-, and *p*-toluidines, *o*- and *m*-nitroanilines, 2 : 4-dinitroaniline, *p*-phenetidine, *o*- and *p*-aminobenzoic acids, *β*-naphthylamine, and the 6- and 8-monosulphonic derivatives of the latter base.

Incidentally, the acetyl-derivative of 1-bromo-*β*-naphthol was prepared; this proved to be a well-crystallising solid, m. p. 56°, and not an oil, as described by Canzoneri (*Gazzetta*, 1882, **12**, 431).

The nitroso-group in nitroso-*β*-naphthol is also mobile, treatment with nitric acid furnishing 1 : 6-dinitro-2-naphthol.

DISCUSSION.

Mr. W. A. DAVIS referred to his results, summarised in the Reports for 1900 to 1903 of the Committee of the British Association on Isomeric Naphthalene Derivatives, showing the mobility of a halogen atom in position 1 in *β*-naphthol under the influence of hydriodic acid or nitric acid. Halogen atoms in other positions in the nucleus were not affected, and the same was true of an *α*-halogen in a non-hydroxylated naphthalene nucleus. The sensitiveness of the *α*-halogen atom in the naphthol was to be attributed to the formation of an additive compound at the *αβ*-ethenoid linking, as was well illustrated in the case of nitric acid by the production of the nitro-bromo-keto-compounds.

Dr. HEWITT, in replying to the President, remarked that he had not encountered any statement concerning the displacement of halogen atoms by azo-groups. The product of the action of diazotised aniline on an alkaline solution of bromo-*β*-naphthol, though very tarry, evidently contained some benzeneazo-*β*-naphthol, since if nitrated in concentrated sulphuric acid solution a certain amount of *p*-nitrobenzeneazo-*β*-naphthol could be isolated.

Mr. Davis' experiments on the action of hydriodic acid on *α*-halogen-substituted *β*-naphthols seemed to be of a different nature, in that the compounds were reduced; it was not the direct replacement of negative atoms by other complex groups.

*126. "The decomposition of nitrocellulose." By Oswald Silberrad and Robert Crosbie Farmer.

Great uncertainty has hitherto prevailed as to the products which result from the gradual deterioration of nitrocellulose. An exhaustive examination of the decomposition products obtained on storage of 100 kilograms of gelatinised nitrocellulose for twenty-three weeks at 54—55° in a damp atmosphere led to the identification of the following products: ethyl nitrate, ethyl nitrite, ethyl alcohol, nitric and nitrous acids, ammonia, formic, acetic, butyric, dihydroxybutyric, oxalic, tartaric, *iso*saccharinic, and hydroxypyruvic acids. Carbohydrates were also present.

*127. "Note on gunpowder and bullets, made about 1641, recently discovered in Durham Castle." By Oswald Silberrad and William Slessor Simpson.

For the materials for this investigation we are indebted to the Secretaries of this Society for putting us into communication with J. T. Johnson, Esq., of Durham School, who kindly forwarded samples of the bullets and gunpowder in question. The ammunition was found in a bucket which had been walled up in the roof of Durham Castle, probably having been placed there about 1641, when the Castle was armed against a Scottish raid.

The bullets consisted of roughly moulded spheres of lead of two different sizes, some being 1·5 cm. and others 1·8 cm. in diameter. On analysis they were found to consist of 99·17 per cent. of lead, and to contain a small quantity of iron and silver together with traces of bismuth, arsenic, and antimony.

The gunpowder, on analysis, was found to approximate closely in composition to the black powder now used in this country. In appearance, however, it differed widely from powder manufactured at the present day, the ingredients having been merely ground and mixed together, no attempt at granulation having been made.

	Analysis of powder from Durham Castle.		Proportions used at present time in this country.
	On sample.	On dry material.	
Potassium nitrate ...	73·99	74·81	75
Carbon...	14·71	14·87	15
Sulphur	9·98	10·09	10
Moisture	1·10		
	99·78		

These results are somewhat surprising, since the compositions used in this country during the seventeenth century all contained a much higher percentage of sulphur. It seems indeed probable that this powder was of Prussian origin, Prussian musket powder being the only explosive of this composition in use at that date.

The calorimetric value was determined by firing a charge at a density of loading 0·48 in a closed vessel suspended in a calorimeter.

The pressure recorded was 9·7 tons per sq. in., or 1478 atmospheres. The calorimetric value = 694 calories per gram.

This is in close agreement with the figure given by ordinary black powder.

The critical time of burning was determined at a density of loading of 0·230. The apparatus used was similar to that described by Sir Andrew Noble (*Phil. Trans.*, 1905, **205**, 201). The pressure was, however, taken on a crusher copper, and the time measured by means of a calibrated tuning-fork, which was simultaneously made to plot a record on a revolving drum.

The pressure recorded at this density was 4·51 tons per sq. inch, 687 atmospheres; ordinary black powder fired at this density gives a pressure of 686 atmospheres (Sir Andrew Noble, *Phil. Trans.*, 1905, **205**, p. 15). The critical time of burning observed was 0·0030 second. This is more rapid than that of the granulated powders now in use.

Unfortunately we were debarred from carrying out further experiments at higher densities owing to the small amount of material at our disposal.

128. "The constitution of acetone." By Millicent Taylor.

The action of sodium and of magnesium methyl iodide on acetone has been studied. So-called "sodium acetone," the product of the action of sodium on highly dilute acetone, is shown to consist of a mixture of caustic soda with a small proportion of sodium *iso*propyloxide; this is deduced from the percentage of sodium in the substance, and also from its behaviour with acid chlorides.

The only esters obtained by the action of chloroformic ester and *p*-nitrobenzoyl chloride on "sodium acetone" are ethyl *iso*propyl carbonate and *iso*propyl-*p*-nitrobenzoate respectively.

In no case was any indication of the formation of *iso*propenyl esters obtained. Moreover, in one case in which the yield of each product was determined, it was found that the total acid chloride employed was converted into acid anhydride, acid (or sodium salt), and *iso*propyl ester, leaving no possibility of the formation of other esters.

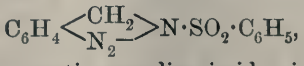
By the action of acetone on magnesium methyl iodide at the ordinary temperature and up to 140° no methane was liberated.

These results prove that acetone does not behave, either towards sodium or Grignard's reagent, as *iso*propenyl alcohol, $CH_3{\cdot}C(OH){:}CH_2$, and also that it does not contain any hydrogen directly replaceable by sodium under the conditions investigated.

129. "Diazo-derivatives of the mixed aliphatic aromatic ω-benzenesulphonylaminobenzylamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

A study of the action of nitrous acid on the benzenesulphonylaminobenzylamines, $NH_2\cdot C_6H_4\cdot CH_2\cdot NH\cdot SO_2\cdot C_6H_5$, showed that diazoimides could be obtained from the ortho- and meta-compounds, but not from the para-isomeride.

o-Nitrobenzylamine was converted successively into *benzenesulphonyl-*o*-nitrobenzylamine*, $NO_2\cdot C_6H_4\cdot CH_2\cdot NH\cdot SO_2\cdot C_6H_5$, and *ω-benzenesulphonyl-*o*-aminobenzylamine*, $NH_2\cdot C_6H_4\cdot CH_2\cdot NH\cdot SO_2\cdot C_6H_5$. This acylated diamine, when diazotised in strong hydrochloric acid, yielded a soluble diazonium salt; this substance, on treatment with aqueous sodium acetate, furnished a colourless mixed *diazoimide*,



$$C_6H_4<\begin{matrix}CH_2\\N_2\end{matrix}>N\cdot SO_2\cdot C_6H_5,$$

which, like the yellow aromatic para-diazoimides, is reconverted into the diazonium salt by the action of cold concentrated hydrochloric acid.

*ω-Benzenesulphonyl-*m*-aminobenzylamine* also gave rise to a soluble diazonium salt which, although not affected by aqueous sodium acetate, underwent condensation in the presence of excess of potassium bicarbonate and furnished a pale yellow *diazoimide* isomeric with the preceding compound.

These diazoimides owe their formation to the presence of hydrogen in the acylamino-group, $\cdot NH\cdot SO_2\cdot C_6H_5$, for when this atom is replaced by methyl, condensation does not occur. The three benzenesulphonylaminobenzylamines and the methyl derivatives of the ortho- and meta-bases all yielded azo-β-naphthol derivatives.

130. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part V. *s*-Dimethyl-4:6-diamino-*m*-xylene." By Gilbert Thomas Morgan and Arthur Clayton.

s-*Dimethyl*-4:6-*diamino*-m-*xylene* (m. p. 100—101°), which was obtained by the following series of operations:

$$C_6H_2Me_2(NH_2)_2 \longrightarrow C_6H_2Me_2(NH\cdot SO_2\cdot C_6H_5)_2 \longrightarrow$$
$$C_6H_2Me_2(NMe\cdot SO_2\cdot C_6H_5)_2 \longrightarrow C_6H_2Me_2(NHMe)_2,$$

yielded a colourless *dinitrosoamine*, $C_6H_2Me_2(NMe\cdot NO)_2$, and on treatment with *p*-nitrobenzenediazonium chloride gave rise to a small amount of the *aminoazo*-compound, $NO_2\cdot C_6H_4\cdot N_2\cdot C_6HMe_2(NHMe)_2$, which separated from benzene either in brownish-grey crusts or in dark red prisms or diamond-shaped plates melting at 218°. This result shows that the symmetrical dimethylation of 4:6-diamino-*m*-xylene does not inhibit the production of an orthoazo-derivative.

131. "Improved apparatus for the determination of molecular weights." By Philip Blackman.

Isotonic solutions of two substances in the same solvent have equal vapour pressures at the same temperature. The state of equilibrium is represented by the equation:

$$\frac{m_1}{m_2} = \frac{w_1}{w_2} \cdot \frac{v_2}{v_1}$$

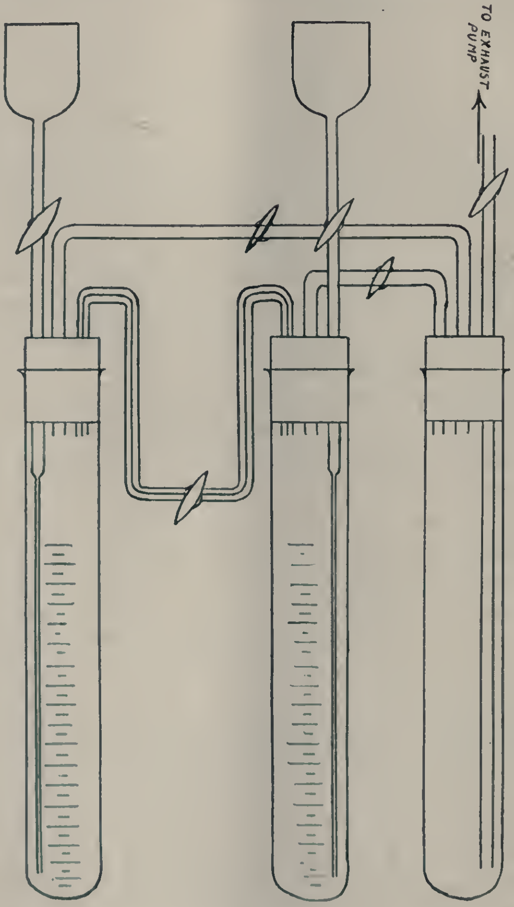
(w_1, w_2 are the weights of the substances of molecular weights m_1, m_2, dissolved in the solvent of volumes v_1, v_2 respectively). If two such solutions, maintained at the same temperature, have their vapours in communication by means of a suitable gauge, the indicator will remain stationary.

Unlike the previous method described by the author (*Trans.*, 1905, **87**, 1474; *Proc.*, 1905, **21**, 304), the success of which depends entirely on the regularity with which the solutions can be made to boil, the new method is free from this difficulty.

Two graduated boiling tubes, and another similar ungraduated tube, are each fitted with a three-holed rubber stopper; through each stopper of the graduated tubes passes a glass-stoppered dropping funnel, the lower end of which is drawn out to a fine point which reaches to the bottom of the tube (a piece of glass tubing, drawn out to a point, may also be fixed by a rubber connection to the end of the funnel just below the stopper). The two graduated boiling tubes are connected by a gauge fitted with a tap, a suitable liquid which is not affected by the vapour of the solvent being used as indicator. These two tubes are connected with the third tube by means of inverted U-pieces, also fitted with taps. The third tube is furnished with a glass-stoppered tube. The three tubes should be arranged in the form of a triangle, so that the apparatus is self-supporting (see figure).

By using equal weights of the substances whose molecular weights are to be compared, the calculations are considerably simplified; the above equation, by making $w_1 = w_2$, becomes $m_1/m_2 = v_2/v_1$.

The weighed quantities of the two substances (about 0·1—0·5 gram) are introduced into the graduated boiling tubes, the stoppers fixed in position, and the necessary connections effected. The taps in the funnels and gauge are kept closed, those in the U-tubes and remaining tube being left open; a little of the solvent is added to the funnels to ensure that no air may find its way into the apparatus. The third tube is then connected, by means of the stoppered tube, with a pump, and as high a vacuum as possible is obtained, after which the taps in the inverted U-pieces are closed. The solvent is now added from the funnels, care being taken to avoid the introduction of air. The solvent must be added in sufficient quantity to cover the lower ends of the funnels. The substances must be left to dissolve, the process being hastened by slightly agitating the apparatus; this also assists in producing uniformity of concentration. The tap in the gauge is cautiously opened (if care is not taken, the liquid serving as index may be forced into one of the solutions), and the movement of the indicator observed. This moves towards the tube in which the vapour pressure is smaller; consequently, if the solvent is added drop by drop from the funnel to that tube, a stage is reached at which the indicator remains stationary. Equilibrium having been attained, the volumes of the solutions are read off. More liquid may now be added to one of



the solutions, and equilibrium re-established by the addition of solvent to the other, when another reading of the volumes is taken. This process is repeated as often as is desirable.

It may be advantageous to maintain the solutions at equal temperatures by standing the apparatus in a trough of water.

The following table shows the results which were obtained. Equal weights of the substances were used in each experiment, the solvent was ether, and concentrated sulphuric acid was used as the index.

Substances. (Those marked with asterisks * were set as tests.)		Ratio m_1/m_2.	
		Theoretical.	Found.
p-Dibromobenzene ($=m_1$)	*p*-Chloronitrobenzene ($=m_2$)	1·50	1·48
Bromo-α-naphthol ($=m_1$)	*p*-Chloronitrobenzene ($=m_2$)	1·42*	1·41
Bromo-α-naphthol ($=m_1$)	1-Chloro-2 : 4-dinitrobenzene.	1·10*	1·13
Picric acid ($=m_1$)	1-Chloro-2 : 4-dinitrobenzene.	1·13	1·12
2 : 4-Dinitrotoluene ($=m_2$)	*p*-Dibromobenzene ($=m_1$)	1·30*	1·32
2 : 4-Dinitrotoluene ($=m_1$)	α-Naphthylamine ($=m_2$)	1·27*	1·25
p-Chloroaniline ($=m_2$)	1-Chloro-2 : 4-dinitrobenzene.	1·59*	1·55
p-Chloroaniline ($=m_2$)	*p*-Nitroaniline ($=m_1$)	1·08*	1·09
Iodoform ($=m_1$)	Hydrazobenzene ($=m_2$)	2·14	2·09
Hydrazobenzene ($=m_2$)	1-Bromo-2 : 4-dinitrobenzene.	1·34	1·35
1-Bromo-2 : 4-dinitrobenzene	Diphenylamine ($=m_2$)	1·46	1·50
β-Naphthylamine ($=m_2$)	Picric acid ($=m_1$)	1·60	1·59
p-Chloroaniline ($=m_2$)	β-Naphthylamine	1·12*	1·19
p-Toluidine ($=m_2$)	α-Naphthylamine ($=m_1$)	1·33	1·34
m-Dinitrobenzene ($=m_1$)	*p*-Nitrotoluene ($=m_2$)	1·22	1·21

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Thomsen, *Julius.* Systematische Durchführung thermochemischer Untersuchungen. Zahlenwerte und theoretische Ergebnisse. Autorisierte Übersetzung von J. Traube. pp. xvi + 382. Stuttgart 1906. (*Recd.* 20/6/06.)

LIST OF FELLOWS, 1906.

The List of Fellows for 1906 is now in active preparation, and no change of address received after 31st July, 1906, can be included in it.

At the next Ordinary Meeting, on **Thursday**, July **5th**, 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be read:

"Saponarin, a new glucoside, coloured blue with iodine." By G. Barger.

"The constitution of umbellulone." By F. Tutin.

"Electrolytic oxidation." By H. D. Law.

"The action of ethyl iodide and of propyl iodide on the disodium derivative of diacetylacetone." By A. W. Bain.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, 5th July, 1906.

Agar, Shelton Gottlieb,
Panorama House, Guernsey.

Assistant Public Analyst and Science (Junior) Lecturer. Assistant to the Public Analyst of Guernsey from June, 1895, to present date. Assistant Science Lecturer to Elizabeth College, Guernsey.

J. Bate Nickolls. F. J. S. Wyeth.
J. A. Williamson. *T. E. Thorpe.*
F. W. Toms.

Anderson, Robert,
Chester Road West, Sunderland.

Chemist. Chemist and Druggist.

Robert McClumpha. Geo. F. Merson.
Frank R. Dudderidge. *H. E. Stevenson.*
James Whittle.

Austin, Percy Corlett, M.A. (Cantab.),
Galway.

Research Assistant with Professor Senier, Queen's College, Galway. Late Scholar Emman. Coll., Camb.; Nat. Sciences Tripos (1901); worked at organic chemistry, Stuttgart, with Prof. Häussermann and Dr. Julius Schmidt (1902 and 1903); appointed Research Assistant Queen's College, Galway (Jan. 1904). Papers: with Dr. Jul. Schmidt: "Ueber einige Umsetzungen des Bis-Trimethyläthylen nitrosats" (*Ber.*, 1902, **35**, 3721), "Polymerie und Desmotropie beim Trimethyläthylen nitrosochlorid" (*Ber.*, 1902, **35**, 3727), "Ueber das Monobromtrimethyläthylen nitrosat" (*Ber.*, 1903, **36**, 1768), "Ueber das 2-Nitrophenanthrenchinon und seine Abkömmlinge" (*Ber.*, 1903, **36**, 3730);

with Prof. Senier: "Halides of the Acridines and Naphthacridines" (*Trans.*, 1904, **85**, 1196), "The Interaction of Acridines with Magnesium Alkyl Halides" (*Trans.*, 1905, **87**, 1469).

A. Senier.	A. Jamieson Walker.
W. Sloan Mills.	Sydney Young.

S. Ruhemann.

Berry, Arthur John,

5, University Gardens, Glasgow.

Student of Chemistry at Glasgow University. Since October, 1905, have been engaged in Research Work. I wish to keep in touch with results of recent research. Obtained First Class Certificate in Chemistry, March, 1904; Certificate of Merit in Metallurgical Chemistry, June, 1905; Certificate of Merit in Advanced Organic Chemistry, June, 1905.

W. Carrick Anderson.	Charles E. Fawsitt.
Frederick Soddy.	T. S. Patterson.

James Roberts, jun.

Bowis, William John,

97, North Road, West Bridgford, Notts.

Student. Four years' experience as assistant in the analytical laboratory of Messrs. Boots' works; 1 year in the bacteriological laboratory of Professor Fresenius in Wiesbaden. Took Ph.D. degree of Zürich University after 3 years' work with Prof. Werner. Dissertation, "Ueber Triamminkobaltiake."

Edward Francis.	*Robert J. Caldwell.*
J. H. Johnston.	*H. C. Sayer.*
Frank Lee Pyman.	*W. C. Reynolds.*

Calam, Harold,

71, Cemetery Road, Beeston Hill, Leeds.

Analytical Chemist. Student at Yorkshire College (now Leeds University), 3 years (1900—1904). Ordinary B.Sc. (Vict.), 1903. B.Sc. (Vict.), 2nd Class, Hons. in Chemistry, 1904. Final A.I.C., 1905. Have been Assistant Chemist under West Riding of Yorkshire Rivers Board, Wakefield, since Feb., 1905.

Arthur Smithells.	C. E. Whiteley.
J. B. Cohen.	W. Lowson.
H. M. Dawson.	H. T. Calvert.

Denton, John,

Horton Villa, Bradford.

Head Chemist and Chemist-Manager to Messrs. Wm. North and Co., Dyers, Bleachers, Mercerisers. Joint author of "The Analysis of Samples of Indigo containing notable amounts of Indirubin," *J. Soc. Dyers*, 1901, **17**. Head Chemist and Chemist-Manager to Wm. North and Co., Dyers, Bleachers, and Sizers and Mercerisers of warps and hank cotton; previous to this, taken the Diploma Course in Chemistry and Dyeing at the Municipal Technical College, Bradford, gaining the full College Diploma and College Certificates; also First Prizeman in each year at the College (3 years). Some time Assistant in the Technical College Chemical Laboratory. Been with Wm. North and Co., as Head Chemist, nearly five years.

Walter M. Gardner.	A. Batty Knaggs.
Barker North.	Saml. F. Stell.

Franklin E. Robertson.

Drinkwater, Lionel John,

27, Stokenchurch Street, Fulham, S.W.

Schoolmaster. Recognised by Board of Education, and registered on Col. B. as a Teacher of Chemistry; Passed Honours Examination, Chemistry. Board of Education Chemistry to B.Sc. Lond. standard.

Will. T. Boone.	Léon E. Walling.
S. F. Dufton.	G. H. G. Plymen.

Percy Elford.

Eaton, Bertie James,

Kuala Lumpur, Federated Malay States.

Government Chemist, Federated Malay States. Three years Finsbury Technical College, Certificated Student. Two years Assistant in the Scientific and Technical Department, Imperial Institute. Late holder of Dorset Senior Science Scholarship. Four times holder of Dixon-Galpin University Extension Scholarships (Dorset); Associate of Institute of Chemistry (Branch E.); Inter. B.Sc. (Lond.).

Wyndham R. Dunstan.	Chas. R. Darling.
Thomas A. Henry.	Henry H. Robinson.
Ernest Goulding.	Albert E. Andrews.

Geo. S. Blake.

Flürscheim, Bernhard,

Heatherlands, Fleet (Hants).

Ph.D. Research Chemist. The following contributions to Chemical Science: *J. pr. Chem.*, **66**, 16; **66**, 321; **68**, 345; **71**, 499. *Ber.*, **34**, 787.

Alexander Scott.	James D. Kettle.
James Dewar.	*Hugo Müller.*

J. Emerson Reynolds.

Gibbs, Reginald William Malyon,

(1) *Before July*, 1906, Hetty Villa, Cam Road, Chesterton, Cambridge ;
(2) *From and after July*, 1906, The Grammar School, Spilsby, Lincolnshire.

Headmaster of Grammar School, Spilsby. (1) Studied Chemistry practically for 1½ years at the laboratory of Messrs. Helbing and Passmore, 63, Queen Victoria Street, E.C., from January, 1897, to June, 1898. (2) Taught Chemistry practically (*a*) at Larchfield, Helensburgh, N.B., September, 1899—June, 1900 ; (*b*) Weston, S. Marychurch, Torquay, January, 1902—March, 1903 (up to Standard of Army and Navy Entrance Examinations). (3) Hold degree of B.Sc (Lond.), October, 1905. (4) Shall hold degree of B.A. (Camb.) from June, 1906.

James D. Kettle. H. Helbing.
Harold F. F. Varley. *Peter MacEwan.*
Frederick B. Power.

Gregory, Thomas William D.,

82, Moorland Road, Burslem, Staff.

Instructor in Experimental Science, Pottery, and Mining Chemistry to Staffordshire Education Committee. Six years a student of Chemistry at Owens College, Manchester. Certificate of Applied Chemistry and Levinstein Exhibitioner of Owens College. Now Lecturer in Chemistry under the N. Staffordshire County Council. Joint author with Prof. W. H. Perkin, jun., of a paper on Hexamethyleneoctocarboxylic Acid, &c., published in the Society's *Transactions*, 1903, **83**, 780.

H. B. Dixon. William A. Bone.
W. H. Perkin, jun. Norman Smith.
D. L. Chapman.

Hedley, Edgar Percy,

6, Royal Terrace, West Kingstown, Co. Dublin.

Student engaged in research in Chemistry and Spectrography in the Royal College of Science, Dublin. Associate of the Royal College of Science, Dublin, in the Faculty of Applied Chemistry.

W. N. Hartley. A. O'Farrelly.
W. E. Adeney. James H. Pollok.
F. G. Donnan.

Hill, Arthur Edwin,

236, Willesden Lane, Brondesbury, N.W.

At present studying Chemistry under Professor Armstrong at City and Guilds Central Technical College. Contributed paper on "New Form of Calcium Chloride Tube for Combustions."

Henry E. Armstrong.	Robert J. Caldwell.
Gerald T. Moody.	S. L. Courtauld.
William A. Davis.	M. O. Forster.

Hopkins, Frederick Gowland,

Stafford House, Newnham, Cambridge.

Reader in Chemical Physiology in the University of Cambridge; Lecturer of Emmanuel College. M.A. (Cambridge), M.B., D.Sc. (Lond.), F.I.C., F.R.S. Author of various contributions, chiefly dealing with physiological chemistry. *Phil. Trans.*, *Proc. Roy. Soc.*, *Journal of Physiology*, &c.

Thos. Stevenson.	Arthur W. Crossley.
Henry E. Armstrong.	M. O. Forster.
Bernard Dyer.	John Wade.

Hughes, John Gerard,

2, Canute Road, Southampton.

Chemist. Member of the Pharmaceutical Society. For some time Science Student at the Hartley University College under Mr. Brierley and Professor Boyd, also late Student in Pharmacy, Borough Analyst, &c., with Mr. W. B. Cowie in Edinburgh. Desiring admission to the Society for use of the Library and Current Literature on Analytical Chemistry.

Will. F. Mawer.	H. Wilson.
J. Brierley.	Wm. B. Cowie.
Harold W. Harrie.	*E. J. Jackman.*
Thomas A. Gerard.	*Maurice B. Jack.*

Jenkinson, Ernest Arthur,

Dauntsey Agricultural School, West Lavington, Wilts.

Schoolmaster. Joint Author, "Studies in the Camphane Series. Part XII" [Trans. Chem. Soc., 1903]. First Class Assoc. in Chemistry, Royal Coll. Sci., London, 1900. Teaching Scholar in Chemistry, Royal Coll. Sci., London, 1900—1902. Demonstrator and Lecturer, Northern Polytechnic Institute, 1901—1902, and Science Master, Dauntsey Agricultural School, 1902—1906.

William A. Tilden.	Chapman Jones.
M. O. Forster.	G. T. Morgan.

James C. Philip.

Macdonald, Thomas,

North Frodingham, Driffield, Yorkshire.

General Manager of Manure Works. I have been a student for four sessions in the Glasgow and West of Scotland Technical College, and have prizes and certificates for Chemistry, and have also been Chemist in various works for about five years before present position.

A. Humboldt Sexton. G. G. Henderson.
Thomas Gray. *R. R. Tatlock.*
R. T. Thomson.

Martin, Frederick James,

Passagem de Marianna, Minas, Brazil.

Assayer and Assistant Reduction Officer. I studied Chemistry at the Camborne School of Mines for two sessions, 1897—1898, made many analyses and investigations under the direction of Mr. J. J. Beringer. Was engaged in 1899 as an Assistant in the Reduction Department (the work being chiefly in connection with a Chemical process for the extraction of gold) of the St. John Del Rey Gold Mines of Brazil, Ltd. I am now Assayer and Assistant Reduction Officer at the works of the Ouro Preto Gold Mines of Brazil, Ltd., having been in the employ of this Company, first as an assistant in the same department, since 1903. I am much interested in Chemistry and Chemical Engineering.

Frederick L. Wilder. J. J. Beringer.
Arthur J. Bensusan. H. R. Beringer.
H. W. Hutchin.

Mills, Herbert Arthur,

Waverley, Bloomfield Gardens, Bath.

Chemist. Pharmaceutical Chemist; M.P.S. Have studied Chemistry at Technical Schools, private tuition, and under the late W. Watson-Will for over a year at the Metropolitan College of Pharmacy, and am desirous of keeping in touch with Chemical world.

Harry Lucas. F. Filmer De Morgan.
David J. Williams. *Frederick B. Power.*
Peter MacEwan.

Mummery, William Rest,

The Firs, Shenfield, Essex.

Analytical Chemist. I have studied Theoretical and Practical Chemistry at King's College, London, under Professor Millar Thomson (1901—1904); engaged in Analytical Chemistry for eighteen months in the Laboratories of Mr. A. C. Chapman, F.I.C., F.C.S.; elected an Associate of the Institute of Chemistry in April, 1906.

John M. Thomson.
Herbert Jackson.
Patrick H. Kirkaldy.
D. Northall-Laurie.
Otto Hehner.
Alfd. C. Chapman.
W. P. Skertchly.

Palmer, Arthur Charles,

17, Wansbeck Gardens, West Hartlepool.

Assistant Science Master, Technical College, West Hartlepool. B.Sc., London, 1905 (1st Division, Chemistry, Physics, and Mathematics). Engaged in teaching Chemistry since 1896, Registered in "Column B" in 1904.

M. O. Forster.
G. T. Morgan.
J. Archyll Jones.
J. W. Patterson.
C. F. Baker.

Pearse, Leonard Edward Beard,

79, Gordon Road, Ealing, W.

Metallurgical Chemist and Assayer. Student for 3 years at the Royal School of Mines, London. Two years Assistant Chemist and Assayer to Mr. G. T. Holloway, 57, Chancery Lane, W.C. Appointed May, 1906, as Metallurgical Chemist at Lead Rolling Works, Calcutta.

W. Gowland.
George T. Holloway.
W. E. F. Powney.
David A. Louis.
William T. Burgess.
W. H. Merrett.
E. O. Courtman.

Pendlebury, Harold Lawson,

4, Wentworth Street, Bolton, and carrying on business at 22, Blackfriars Street, Salford, Manchester.

Analytical and Consulting Chemist. Analyst, studied Honours at Manchester Tech. School. Assistant, Bolton Borough Analyst. Assistant (Chief) to the late Geo. H. Hurst, Esq., F.C.S.

Charles A. Fogg.
Ernest Boardman.
H. Rostron.
T. M. Nightingale.
Jno. L. Whiteside.

Pennymore, Percy George,

Eskbank Iron and Steel Works, Lithgow, New South Wales.

Metallurgist and Blast Furnace Manager. Fourteen years' practical

Laboratory experience, of which six years as Chief Analytical Chemist to the Blaenavon Co., Ltd.

J. Jas. Morgan.	R. W. Atkinson.
Lawrence Dufty.	*Geo. R. Thompson.*

Pattinson B. Melmore.

Pickles, Samuel Shrowder, B.Sc. (Vict.).

Research Chemist at the Imperial Institute, South Kensington. B.Sc. (Victoria University, Manchester). 1st Class Honours Chemistry. For two years private research Assistant to Prof. W. H. Perkin, jun., F.R.S. Joint author with Prof. Perkin of the following papers: "The Reduction of *iso*Phthalic Acid," "Experiments on the Synthesis of the Terpenes. Part II," "Experiments on the Synthesis of the Terpenes. Part III," and several other papers published in the Proceedings of the Chemical Society.

Wyndham R. Dunstan.	J. F. Thorpe.
Harold B. Dixon.	R. S. Hutton.
D. L. Chapman.	W. H. Perkin, jun.

Pye, Thomas Ebenezer,

"West View," Summersdale, Chichester.

Engineer and Manager, The City of Chichester Gas Company. Assistant Lecturer and Demonstrator under Wm. F. Lowe, Esq., F.I.C., A.R.S.M., &c., at the South Kensington Science and Art Department Chemistry Class at Chester. Lecturer to the Chester Society of Natural Science on "The Extraction of Ammonia from Blast Furnace Gases." Official Tester and Gas Analyst for Chester Gas Co. for seven years, and for Shrewsbury Gas Co. for four years. Author of The Manufacture and Purification of Coal-gas "for Gas Students," published by the *Journal of Gas-lighting*, Vols. LIX, LX, LXI, LXII, including two articles on "The use of Oxygen as an aid to Lime Purification, and its Behaviour in the Lime Boxes." Author of numerous popular lectures and pamphlets on "The Chemistry of Gas Combustion."—Five of the Chemistry Articles for Gas Students are herewith submitted.

W. F. Lowe.	Norton H. Humphrys.
Vivian B. Lewes.	H. Leicester Greville.
John Bairstow.	*A. J. Greenaway.*

Rawles, Walter Hansen,

81, Lewisham High Road, London, S.E.

Analytical Chemist. I studied Chemistry for four years at the Technical College, Finsbury, E.C., under Professor Meldola, F.R.S., &c.,

and I now hold the position of Analytical Chemist to Peak, Frean & Co., Ltd., Biscuit Manufacturers, Bermondsey, S.E.

R. Meldola. Lewis Eynon.
John Castell-Evans. Harley F. Knight.
Edward W. Bealey.

Salmon, Frederick John,

c/o Princess Estate and Gold Mining Co., P.O. Box 112,
Roodepoort, S.A.

Technical Chemist. Studied four years at the Central Technical College, S. Kensington, and took the Diploma in Technical Chemistry. Worked six months in the Laboratory of G. T. Holloway, Chemist and Metallurgist, of Chancery Lane. Now engaged in Cyanide work on the Rand.

James Moir. Gerald T. Moody.
Henry E. Armstrong. William A. Davis.
Robert J. Caldwell.

Seaber, Willie Macro,

Firdale, Sheen Lane, East Sheen.

Analytical Chemist, at present engaged in Eley Bros.' Cartridge Works. Bachelor of Science (Lond.); about four years with Leo Taylor, F.I.C., Public Analyst for Hackney; three months with R. A. Cripps, F.I.C., Public Analyst for Bournemouth; one year at University Tutorial College, Holborn.

Percy Edgerton. J. W. Shepherd.
B. S. Evans. *Arthur J. Starey.*
Harold W. Harman.

Senior, John,

Sizing Hill, Batley Carr, Dewsbury.

Manager and Chemist to Messrs. Joseph Senior and Sons, Soap Works, Dewsbury. I have been a student at the Dewsbury Technical School, in the Chemistry and Physics Departments, for the past nine years. Have passed Board of Education Examinations in Theory and Practical Chemistry (Honours, Organic and Inorganic). I wish to keep my chemical knowledge up-to-date.

Herbert John Taylor. Isaac Patchett.
Robert Gawler. R. S. Cahill.
C. E. Womersley. *Joseph Brown.*
Thos. Holgate.

Shepherd, Arthur Burton,

18, Stafford Street, Hull.

Analytical Chemist. A four years' Course in Chemistry at Yorkshire College, Leeds; also Bacteriology at Leeds Medical School. Three years Assistant to Mr. T. Fairley, Leeds City and County Analyst. Two years Chemist to British Oil and Cake Mills, Hull. Degrees obtained: B.Sc. (Vict.), Hons. Chem., F.I.C.

Arthur Smithells. H. M. Dawson.
Thomas Fairley. C. E. Whiteley.
J. B. Cohen. W. Lowson.
B. A. Burrell.

Smith, Fred,

Cliff House, Bruntcliffe.

Analyst at Cliffe Mills, and desires to join the Chemical Society in order to be brought into touch with all recent work.

T. W. Lockwood. William W. Tunnicliffe.
Saml. F. Stell. *Walter M. Gardner.*
B. North.

Stirimer, Emanuel George,

Park House, Margery Park Road, Forest Gate.

Manufacturing Chemist. Received general education, and attended special classes in Chemistry at Central Foundation School, Finsbury. Studied Inorganic and Organic Chemistry (Theoretical and Practical) for 2¼ years under Mr. E. G. Clayton, F.C.S., F.I.C., and for 1 year at the West Ham Technical Institute under Messrs. G. Dean, M.A., F.C.S., and F. H. Streatfeild, F.C.S.

Edwy G. Clayton. F. Henry Streatfeild.
George Dean. *F. G. Adair Roberts.*
John Castell-Evans.

Treble, Richard Lumley,

The School Lodge, Cranbrook, Kent.

Schoolmaster. B.Sc., Durham, in Mathematics and Chemistry; late Exhibitioner in Science at the Armstrong College, Newcastle-on-Tyne, and Freire-Marreco Medallist in Chemistry; at the present time Senior Science Master in the Cranbrook Grammar School (1903—1906), previously Science Master in the Newbury Grammar School (1900—1902), and in the Market Harborough Grammar School (1899—1900).

P. Phillips Bedson. W. H. Bentley.
F. C. Garrett. H. R. Rogers.
H. G. F. Micklewright.

Turnbull, Robert Hutchison,

Messrs. MacAndrews and Forbes Co., Smyrna, Turkey-in-Asia.

Chemist. Eight years with Messrs. Nobel's Explosives Co., Ltd., as analytical, research, and superintending chemist. At present, Chief Chemist to the MacAndrews and Forbes Co., New York and Smyrna. Associate of the Glasgow Technical College. Fellow of the Institute of Chemistry.

G. G. Henderson. A. Humboldt Sexton.
Thomas Gray. *T. S. Patterson.*
Charles E. Fawsitt.

Watts, James Neil,

P. O. Eikenhof, Johannesburg, South Africa.

Principal of Government School, Transvaal. English Board of Education, Elementary and Advanced Certificate in Theoretical and Practical Chemistry, Hygiene, and Physiography. Distinction Certificate University Lectures on Geology (I wish to receive the Society's Publications and keep *au courant* with modern Chemistry).

Arthur C. Claudet. Robt. G. Grimwood.
Arthur J. Chapman. *W. J. Dibdin.*
R. Grimwood.

Wightman, Charles,

43, Portland Place, London, W.

Merchant. Have been connected with Chemical Manufacturing for more than forty years.

M. O. Forster. Edward Divers.
A. Gordon Salamon. Julian L. Baker.
R. Meldola.

Wren, Henry,

22, Stapleton Hall Road, Stroud Green, N.

Lecturer on Chemistry. "Synthese von Arylnitromethanen u. symmetrischen Stilbenderivaten." W. Wislicenus and H. Wren, *Ber.*, 38, 502.

A. Vernon Harcourt. John Watts.
H. Brereton Baker. N. V. Sidgwick.
Andrea Angel.

Young, George,

38, Havelock Street, Sheffield.

Science Master, Central Secondary School, Sheffield. Bachelor of Arts, Royal University of Ireland; Bachelor of Science, University of London. Science Master in School of Science, Central and Secondary School, Sheffield, nine and a half years. Lecturer and Teacher in Hygiene and Sanitary Science in Evening Department of Central Secondary School, Sheffield, ten years. Assistant Lecturer in Electrical Engineering, Technical Department of University College, Sheffield, seven years.

L. T. O'Shea. Fredk. Cowling.
Chas. Bradshaw. Morton E. Wager.
Walter N. Edwards.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I (3):

Hertz, Dr. Charles H.,
Chapel Hill, N.C., U.S.A.

Professor of Chemistry, University of North Carolina. Researches on Double Halides of Lead and Potassium, Mixed Double Halides of Platinum and Potassium, Study of the Constitution of Inorganic Compounds (with A. Werner, of Zürich), Ph.B., Univ. of Georgia, Ph.D., Johns Hopkins University.

Francis P. Venable. F. W. Clarke.
Ira Remsen. *J. W. Mallett.*
F. P. Dunnington.

Sanyal, Surendra Prasad,
Majhowli Raj, Gorakhpur Dt., U.P., India.

Private Secretary to the Rajah Bahadur of Majhowli. Took the B.A. degree in Physical Science, and then specialised in Chemistry, taking the 2nd D.Sc. (M.A.) in that subject at the Allahabad University. Is desirous of being in touch with modern improvements in Chemistry.

B. M. Mukerjee. A. Sanyal.
P. P. Phillips.

Sime, Allan,
Kingston, Jamaica.

Analyst. For $4\frac{1}{2}$ years assistant to H. H. Cousins, Esq., in the Analytical Department, Government Laboratory, and Sugar Experiment Station, Kingston, Jamaica.

H. H. Cousins. H. S. Hammond.
J. H. Roberts. *A. D. Hall.*

Wortley, Edward Jocelyn,

Rectory, Half-way Tree, Jamaica.

Assistant Island Chemist of the Government Laboratory, Jamaica. Second Assistant Chemist and Instructor in Analytical Chemistry to Agricultural Students, 1902—1905; appointed Assistant Island Chemist in August, 1905; these appointments held at Government Laboratory, Jamaica.

H. H. Cousins.	H. S. Hammond.
J. H. Roberts.	*A. D. Hall.*

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK

Issued 18/7/06

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

Vol. 22. No. 313.

Thursday, July 5th, 1906, at 8.30 p.m., Professor R. Meldola, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Reginald de Vere Cornwall, Medical and Public Health Dept., Salisbury, Rhodesia, S. Africa.
Henry Ernest Crocker, 452, Slade Road, Gravelly Hill, Birmingham.
James Herbert Dinwoodie, Johannesburg.
Gopal Chandra Sen, M.A., 23, Bond Street, Leeds.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Shelton Gottlieb Agar.
Robert Anderson.
Percy Corlett Austin, M.A.
Arthur John Berry.
William John Bowis, Ph.D.
Harold Calam, B.Sc.
John Denton.
Lionel John Drinkwater.
Bertie James Eaton.
Bernhard Flürscheim, Ph.D.
Reginald William Malyon Gibbs, B.Sc.
Thomas William D. Gregory.
Edgar Percy Hedley.
Charles H. Hertz, Ph.D., Ph.B.
Arthur Edwin Hill.
Frederick Gowland Hopkins, M.A., M.B., D.Sc., F.R.S.
John Gerard Hughes.
Ernest Arthur Jenkinson.
Thomas Macdonald.
Frederick James Martin.
Herbert Arthur Mills.
William Rest Mummery.
Arthur Charles Palmer, B.Sc.
Leonard Edward Beard Pearse.
Harold Lawson Pendlebury.
Percy George Pennymore.
Samuel Shrowder Pickles, B.Sc.
Thomas Ebenezer Pye.
Walter Hansen Rawles.
Frederick John Salmon.
Surendra Prasad Sanyal, D.Sc.
Willie Macro Seaber, B.Sc.
John Senior.
Arthur Burton Shepherd, B.Sc.
Allan Sime.
Fred Smith.
Emanuel George Streimer.
Richard Lumley Treble, B.Sc.
Robert Hutchison Turnbull.
James Neil Watts.
Charles Wightman.
Edward Jocelyn Wortley.
Henry Wren.
George Young, B.A. B.Sc.

Of the following papers, those marked * were read:

*132. "Saponarin: a new glucoside coloured blue with iodine."
By George Barger.

Dissolved in the cell sap of the leaf epidermis of various plants, there occurs a substance which is coloured blue by iodine, and which is known to botanists as "soluble starch." This substance has been isolated from *Saponaria officinalis*, and is a glucoside; the name saponarin is suggested for it.

Saponarin crystallises in microscopic needles melting at 231—232°, and having the composition $C_{21}H_{24}O_{12},2H_2O$. The glucoside dissolves in alkalis with a yellow colour, gives with ferric chloride a reddish-brown coloration, and with iodine a substance closely resembling that formed from starch.

Ennea-acetyl saponarin, $C_{21}H_{15}O_{12}(C_2H_3O)_9$, melts at 183—185° and crystallises in needles.

Acids hydrolyse saponarin, thus:

$$C_{21}H_{24}O_{12} + H_2O = C_6H_{12}O_6 + C_{15}H_{14}O_7,$$

yielding glucose and vitexin, a colouring matter obtained by A. G. Perkin from a New Zealand dye wood (*Trans.*, 1898, **73**, 1030, and 1900, **77**, 416).

At the same time another colouring matter is formed, apparently isomeric with vitexin, or closely related to it, for which the name saponaretin is suggested. Vitexin and saponaretin both yield phloroglucinol and *p*-hydroxyacetophenone on boiling with caustic potash. Molecular weight determinations of vitexin and of acetyl vitexin prove that Perkin's formula, $C_{21}H_{20}O_{10}$, must be changed to $C_{15}H_{14}O_7$. Vitexin differs therefore from apigenin by two molecules of water, and probably is a flavanone derivative containing either a reduced pyrone ring or a reduced phloroglucinol nucleus. It would be a representative of a new class of colouring matters to which scoparin, which Perkin regards as methoxy-vitexin, would also belong.

Discussion.

The President asked whether the new glucoside was widely distributed in the vegetable kingdom, and whether it was contained in any considerable quantity in any particular plant. He also asked whether the isomeride of vitexin was, in the author's opinion, to be regarded as a natural product, or whether it resulted from the isomerisation of vitexin during the hydrolysis of the glucoside. He considered that Dr. Barger had satisfactorily established the identity of the product of hydrolysis of his glucoside with vitexin, and that he had also established the formula of the latter compound. He considered that the author had made an important contribution to plant chemistry.

Mr. Grant Hooper said that in the microscopic examination of vegetable substance, traces of what had hitherto been regarded as soluble starch were not infrequently observed. He would like to know whether Dr. Barger had detected and identified the interesting glucoside which he had just shown them in substances other than those from which he had isolated the new compound.

Dr. Barger, in reply, said that saponarin, which is optically active, occurs in about twenty plants; one of the richest of these, namely, *Saponaria*, contains less than 1 per cent. of the weight of dry leaves. Saponaretin is a product of secondary decomposition; vitexin is formed from the pure glucoside.

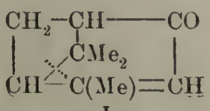
*133 "The constitution of umbellulone." By Frank Tutin.

The ketone, umbellulone, was isolated from the essential oil of *Umbellularia Californica* by Power and Lees (*Trans.*, 1904, **85**, 629), who showed it to possess the formula $C_{10}H_{14}O$.

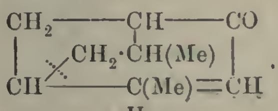
The behaviour of umbellulone towards certain reagents was further studied by Lees (*Trans.*, 1904, **85**, 639), and its investigation has been continued by the present author.

Umbellulone, on oxidation, yields a *saturated keto-acid*, $C_9H_{14}O_3$ (m. p. 102°), called *umbellulonic acid*, which, on distillation under suitable conditions, is partially converted into an *unsaturated lactone*, $C_9H_{12}O_2$ (b. p. 217—220°). This lactone, on hydrolysis, yields umbellulonic acid, and is produced by the elimination of water from the enolic modification of the keto-acid. On oxidation, a polymethylene dicarboxylic acid, *umbellularic acid*, $C_8H_{12}O_4$ (m. p. 120—121°), is obtained, which is remarkably stable.

By the bromination of umbellulone, and subsequent distillation of the products, *p*-cymene was obtained, together with substances containing bromine. It would therefore appear that the molecule of umbellulone has a structure capable of yielding this hydrocarbon without undergoing any profound change. The only formulæ which offer a satisfactory explanation of the behaviour of umbellulone on oxidation and on bromination are the following:



I.



II.

Both these substances, through the rupture of the bridge by the addition of hydrogen at the point indicated by the dotted line, would give compounds capable of yielding *p*-cymene. Formula I represents a keto-pinene, which would yield, on oxidation, a dimethyltetramethylene dicarboxylic acid, identical or stereoisomeric with the norpic acid obtained by the oxidation of pinene. On the other hand, the compound represented by formula II would yield 1-methylpentamethylene 3 : 5-dicarboxylic acid.

It is considered most probable that formula II represents the constitution of umbellulone.

Discussion.

Dr. Power congratulated Mr. Tutin on the accomplishment of this excellent work. He thought the evidence brought forward was so complete as to leave no doubt respecting the correctness of the constitutional formula assigned to umbellulone by Mr. Tutin. It was of interest to note that only one other ketone possessing the same empirical formula as umbellulone, namely, carvone, had been observed to occur in nature, but this had a very different constitution.

*134. "The action of ethyl iodide and of propyl iodide on the disodium derivative of diacetylacetone." By Alexander William Bain.

As the result of the action of ethyl iodide on the disodium derivative of diacetylacetone, suspended in alcohol, the following substances have been obtained:

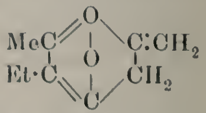
(1) Dimethyldiethylpyrone, $C_{11}H_{16}O_2$ (m. p. 64°).

(2) Dimethylethylpyrone, $C_9H_{12}O_2$ (m. p. 58°).

Each forms a hydrochloride and a platinichloride.

(3) Diethyldiacetylacetone, $C_{11}H_{18}O_3$.

(4) A compound, $C_9H_{12}O_2$ (m. p. 66—67°, b. p. 289°), isomeric with dimethylethylpyrone, to which the formula



is ascribed. This compound on boiling with concentrated hydrochloric acid yields dimethylethylpyrone hydrochloride, and by the action of sodium hydroxide solution is changed into an orcinol derivative.

By the action of propyl iodide on the disodium derivative of diacetylacetone, the author has obtained dimethylpropylpyrone, $C_{10}H_{14}O_2$, and also an isomeric substance which possesses similar properties to the corresponding ethyl compound.

135. "A possible source of error in Stas's nitrogen ratios." By Robert Whytlaw Gray.

Stas's higher value for the atomic weight of nitrogen is supported by very little evidence.

Not only do the researches of Rayleigh, Leduc, D. Berthelot, Guye, and the author confirm the lower value, but an indirect comparison of the atomic weights of nitrogen and silver from the results of Marignac, Scott, and Richards leads to the same result.

By assuming similar errors in the ratio Ag : NH_4Cl and Ag : NH_4Br of Stas as those found for the ratio Ag : NaCl by Richards and Wells, the value for nitrogen deduced is 14·011. The possible sources of error in the other ratios are discussed.

136. "Electrolytic oxidation." By Herbert Drake Law.

On oxidising benzoin by the electrolytic method, three products are formed, namely, benzil, benzaldehyde, and benzoic acid, as shown by the following equations:

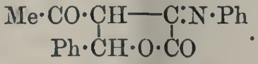
$$C_6H_5\cdot CH(OH)\cdot COC_6H_5 + O = C_6H_5\cdot CO\cdot COC_6H_5 + H_2O,$$
$$C_6H_5\cdot CH(OH)\cdot COC_6H_5 + O = C_6H_5\cdot CHO + C_6H_5\cdot CO_2H.$$

In addition to these, however, a certain amount of tarry matter is always obtained. This formation of complex tarry matter is a property of high potential discharge at the anode, and always takes place in the case of unsaturated compounds. The amount of any of these products which is formed is influenced very largely by the conditions of the experiment. Thus, strongly acid solutions promote the formation of tar, but none is observed when the anodic discharge is kept low. Similar experiments conducted with compounds resembling benzoin gave results agreeing with the above. Thus, cuminoin on being oxidised electrolytically forms cumic acid, cuminol, and tar. Furoin forms furil and tar, benzfuroin gives benzoic acid and tar, whilst anisoin and piperonyloin yield nothing but complex resinous matter of unknown constitution.

137. "The ethyl esters of acetonyloxalic and acetophenyloxalic acids and the action of ethyl oxalate on acetanilide and its homologues." By Siegfried Ruhemann.

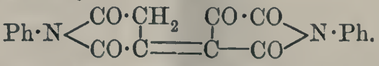
The research was suggested by a note of Claisen's (*Ber.*, 1891, 24, 128) that ethyl sodioacetonyloxalate, on boiling with glacial acetic acid, yielded the sodium compound possessing the empirical formula

$C_5H_3O_3Na$. This is violet, as is the substance which Ruhemann and Merriman (*Trans.*, 1905, **87**, 1383) obtained in the course of their investigation on the reaction between phenylpropiolyl chloride and sodioacetylacetone. The compounds which are produced by the condensation of aromatic aldehydes with the ethyl esters of acetonyloxalic and acetophenyloxalic acids react with aniline and its homologues to yield yellow substances, which are constituted according to the type:



$$\begin{array}{l}\mathrm{Me{\cdot}CO{\cdot}CH{-\!-}C{:}N{\cdot}Ph}\\ \qquad\mathrm{Ph{\cdot}CH{\cdot}O{\cdot}CO}\end{array}.$$

With the object of ascertaining whether a relationship exists between these yellow substances and xanthoxalanil, which W. Wislicenus and Sattler (*Ber.*, 1891, **24**, 1245) obtained, although in an impure form, from acetanilide and ethyl oxalate, the author has repeated the experiments of these chemists and has prepared xanthoxalanil in a pure state by crystallisation from nitrobenzene; its constitution is expressed by the formula



$$\mathrm{Ph{\cdot}N}\!<\!\begin{array}{l}\mathrm{CO{\cdot}CH_2\quad CO{\cdot}CO}\\ \mathrm{CO{\cdot}C{=\!=\!=}C{-\!-}CO}\end{array}\!>\!\mathrm{N{\cdot}Ph}.$$

Similar compounds have been prepared by using, instead of acetanilide, aceto-*p*-toluidide (see Wislicenus and Sattler, *loc. cit.*), aceto-*o*-toluidide, and aceto-α-naphthalide. These substances differ from each other, especially in colour and solubility. Xanthoxalanil is deep orange and sparingly soluble in nitrobenzene, xanthoxalo-*p*-toluidide, $C_{22}H_{16}O_5N_2$, is lighter in shade and more soluble, whilst the corresponding ortho-compound is canary-yellow and readily dissolves in this solvent; finally, xanthoxalo-α-naphthylanil, $C_{28}H_{16}O_5N_2$, is also yellow, but dissolves in glacial acetic acid.

138. "An oxidation product of indigotin."

By Arthur George Perkin.

It has been shown by Sommargua (*Annalen*, 1879, **195**, 305) that, on sublimation under reduced pressure, refined natural indigo yields pure indigotin; again, Bloxam (*Trans.*, 1905, **87**, 982) has found that this is the case with the commercial synthetical product. With limited access of air, however, pure indigotin and also these commercial varieties give a small quantity of a yellow sublimate which crystallises in needles, m. p. 258—259°, is very sparingly soluble in alcohol, and can be distilled without appreciable loss. It appears to have the formula $C_{15}H_8O_2N_2$ (Found, $C=72{\cdot}59$; $H=3{\cdot}17$; $N=11{\cdot}59$ per cent.), is very resistant to acid oxidising agents, but on boiling with strong potassium hydrate solution gives anthranilic acid. When treated in boiling glacial acetic acid solution with hydriodic acid, an unstable *hydriodide*, forming colourless, prismatic needles (Found, N=

7·42 per cent.), is produced; this, on treatment with water, splits off hydriodic acid and is reconverted into the substance $C_{15}H_8O_2N_2$; it is therefore probably the salt of an unstable reduction product of the latter. On reduction with tin and hydrochloric acid, a *compound*, $C_{15}H_{12}ON_2$ (Found, C = 76.33; H = 5·34; N = 11·88 per cent.), crystallising in colourless needles, m. p. 190—193°, is formed, which on oxidation is reconverted into the substance $C_{15}H_8O_2N_2$. A trace of indole is also formed during the reduction. By the prolonged action of hydriodic acid, a compound crystallising in yellow needles, m. p. 200—203°, is produced, which can also be reoxidised to the original product. The author hopes to devise a better method for preparing this yellow compound, as hitherto, with much labour, only 8 grams of the pure substance could be obtained from 2 lb. of indigo.

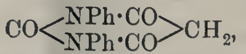
139. "Indigo-yellow." By Arthur George Perkin.

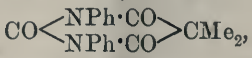
In a previous communication (*Proc.*, 1904, **20**, 172) it was shown that the yellow colouring matter usually present in Java indigo is kampherol. Examination has now shown that it is derived from a glucoside present in the leaves of the Java and Natal indigo plants (*Indigofera arrecta*), which is probably hydrolysed during the fermentation process. The material employed was chiefly the air-dried Natal leaf. This glucoside, for which the name *Kampheritrin* is proposed, has the formula $C_{27}H_{30}O_{14}$ (Found, after being dried at 100°, C = 56·00; H = 5·27 per cent.); the air-dried substance contains 3½ mols. of water (Found, $H_2O = 9·79$ per cent.). It crystallises in colourless needles, which are sparingly soluble in water, is very nearly devoid of tinctorial properties, and, when heated, congeals together at 190—192° and melts at 201—203°. It is hydrolysed by acids according to the equation

$$C_{27}H_{30}O_{14} + 4H_2O = C_{15}H_{10}O_6 + 2C_6H_{14}O_6$$

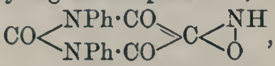
into kampherol (Found, $C_{15}H_{10}O_6 = 49·19$ per cent.) and rhamnose, identified by means of its osazone. Analyses of the kampherol thus obtained, m. p. 275—277° (Found, C = 63·01; H = 3·68 per cent.), and its acetyl compound, m. p. 181° (Found, C = 60·77; H = 4·43 per cent.), were made for purposes of confirmation. By the method employed, 1·5 per cent. of the glucoside was isolated, but considerably more of this is really present, as 2 per cent. of an impure kampherol contaminated with a reddish-brown substance, probably the so-called "indigo-brown," could be obtained by hydrolysing the aqueous extract of the leaf.

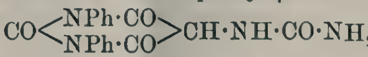
140. “1 : 3-Diphenylbarbituric acid and some coloured derivatives. Synthesis of 1 : 3-diphenyluric acid.” By Martha Annie Whiteley.

1 : 3-*Diphenylbarbituric acid*,  $\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{CH_2}$, prepared by heating malonyl chloride and carbanilide or malonic acid, phosphorus oxychloride and carbanilide in chloroform solution, forms colourless, prismatic needles and melts at 238° ; the *dimethyl* derivative,

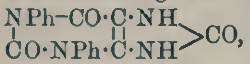


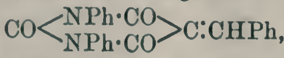
$$\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{CMe_2},$$

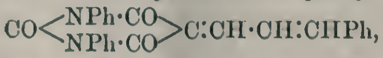
crystallises in colourless needles, melts at 230°, and sublimes at a slightly higher temperature ; the iso*nitroso*-derivative (*diphenylvioluric acid*),  $\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{C}{<}\begin{smallmatrix}\mathrm{NH}\\ |\\ \mathrm{O}\end{smallmatrix}$, crystallises in colourless needles, melts and decomposes at 227°, and yields the red or violet salts characteristic of this type of compound ; the *potassium*, *aniline*, and *piperidine* salts were prepared ; the *acetyl* derivative, $\mathrm{C_{16}H_{10}O_3N_3\cdot OAc}$, crystallises in colourless prisms and melts at 245°. 1 : 3-*Diphenyl*-5-*aminobarbituric acid* (1 : 3-*diphenyluramil*), obtained by reducing diphenylvioluric acid, forms colourless crystals, melts and decomposes at 195°, and condenses with potassium cyanate to form 1 : 3-*diphenyl*-ψ-*uric acid*,



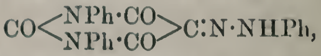
$$\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{CH\cdot NH\cdot CO\cdot NH_2},$$

which crystallises in colourless prisms, melts and decomposes at 217°, and on boiling with hydrochloric acid yields 1 : 3-*diphenyluric acid*,  $\begin{smallmatrix}\mathrm{NPh{-}CO\cdot C\cdot NH}\\ |\qquad\quad \|\\ \mathrm{CO\cdot NPh\cdot C\cdot NH}\end{smallmatrix}{>}\mathrm{CO}$, which crystallises in colourless needles, softens at 238°, but does not melt at 306°.

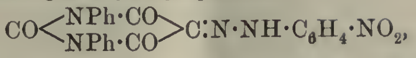
1 : 3-Diphenylbarbituric acid condenses readily with aromatic aldehydes or diazonium chlorides, and the resulting compounds are of a bright yellow or orange colour. 5-*Benzylidene*-1 : 3-*diphenylbarbituric acid*,  $\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{C{:}CHPh}$, forms pale yellow, prismatic needles from most of the ordinary solvents, crystallises from acetone or ethyl acetate in a mixture of colourless and yellow needles, each form melting sharply at 214°, and yielding on reduction 5-*benzyl*-1 : 3-*diphenylbarbituric acid* ; 5-*cinnamylidene*-1 : 3-*diphenylbarbituric acid*,



$$\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{C{:}CH\cdot CH{:}CHPh},$$

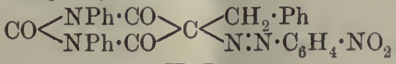
forms bright yellow needles and melts and decomposes at 268°. 1 : 3 - *Diphenylalloxanphenylhydrazone*,  $\mathrm{CO}{<}\begin{smallmatrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{smallmatrix}{>}\mathrm{C{:}N\cdot NHPh}$, forms bright yellow needles and melts and decomposes at 264° ;

1 : 3-*diphenylalloxan*-p-*nitrophenylhydrazone*,

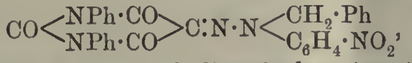


$$\mathrm{CO}<\begin{matrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{matrix}>\mathrm{C{:}N\cdot NH\cdot C_6H_4\cdot NO_2},$$

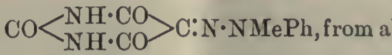
forms well-developed orange prisms and melts at 274°; 1 : 3-*diphenylalloxanbenzyl*-p-*nitrophenylhydrazone*,



$$\mathrm{CO}<\begin{matrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{matrix}>\mathrm{C}<\begin{matrix}\mathrm{CH_2\cdot Ph}\\ \mathrm{N{:}N\cdot C_6H_4\cdot NO_2}\end{matrix}$$

or 

$$\mathrm{CO}<\begin{matrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{matrix}>\mathrm{C{:}N\cdot N}<\begin{matrix}\mathrm{CH_2\cdot Ph}\\ \mathrm{C_6H_4\cdot NO_2}\end{matrix},$$

from 5-benzyl-1 : 3-diphenylbarbituric acid and diazotised *p*-nitraniline, crystallises in beautiful yellow prisms and melts and decomposes at 180°. *Alloxanphenylmethylhydrazone*, 

$$\mathrm{CO}<\begin{matrix}\mathrm{NH\cdot CO}\\ \mathrm{NH\cdot CO}\end{matrix}>\mathrm{C{:}N\cdot NMePh},$$

from alloxan and phenylmethylhydrazone, crystallises in brick-red, hexagonal plates, which melt and decompose at 189—190°.

141. "The alkylation of rhamnose." By Thomas Purdie and Charles Robert Young.

By complete methylation with silver oxide and methyl iodide, acetone- and methyl-rhamnosides yield respectively *dimethyl acetonerhamnoside* and *trimethyl methylrhamnoside*, and by hydrolysing these compounds *di-* and *tri-methylrhamnose* respectively are obtained. The rhamnose derivatives described are liquids, but, all of them excepting dimethyl rhamnose being volatile without decomposition, it was possible to isolate them by fractional distillation under reduced pressure.

Dimethyl- and trimethyl-rhamnose give crystalline phenylhydrazones, and display the ordinary properties of reducing sugars. Trimethyl rhamnose is reconverted into trimethyl methylrhamnoside by condensation with methyl alcohol and also by the silver oxide method of alkylation; the former process gives mainly the α-form of the aldoside, the latter a mixture composed largely of the β-form. The presence of the β-isomeride was recognised not only by its rotatory power, but also by the rapidity of its hydrolysis. The rotatory powers of the substances described fall into line with those of glucose and its corresponding derivatives.

142. "The alkylation of *l*-arabinose." By Thomas Purdie and Robert Evstafieff Rose.

By methylating Fischer's α-methylarabinoside with silver oxide and methyl iodide, *trimethyl α-methylarabinoside* is obtained in large, well-formed crystals (m. p. 43—45°), and by hydrolysing this with dilute hydrochloric acid *trimethyl arabinose* is produced. This substance is a liquid (b. p. 148—152°, 19 mm.), but otherwise it exhibits the usual properties of a reducing sugar. It can be methylated by condensation with methyl alcohol, and also by treatment with methyl iodide and silver oxide, the product in both cases being a mixture of the isomeric trimethyl methylarabinosides. The condensation process yields the crystalline α-isomeride in large proportion, the silver oxide process mainly the β-isomeride. The latter substance is apparently a liquid and it could not be isolated, but its presence in the mixture was recognised by its undergoing hydrolysis more rapidly than the isomeric α-form.

In preparing Fischer's α-methylarabinoside, a small quantity of the *β-methylarabinoside* was obtained in crsytalline prisms melting at 115—117°.

With respect to rotatory power, the isomeric methylarabinosides and trimethyl methylarabinosides show relations similar to those of the corresponding derivatives of *d*-glucose.

143. "The esters of triacetic lactone and triacetic acid." By Foster Sproxton.

Ethyl triacetate, $Me{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CH_2{\cdot}CO_2Et$, is formed by heating triacetic lactone with dry alcohol in sealed tubes, and may be obtained pure by decomposing its copper salt with sulphuretted hydrogen. It gives a deep red coloration with ferric chloride.

The *ethyl* and *methyl* salts of triacetic lactone have been prepared by the action of ethyl and methyl iodides on the silver salt of the lactone. The ethyl ester could not be obtained in the pure condition. Like the analogous esters of dehydracetic acid, they have an acid reaction in aqueous solution. This property has been shown to be due, in both the triacetic lactone and dehydracetic acid derivatives, to partial hydrolysis of the esters by water. Complete hydrolysis takes place on boiling, and the parent lactone can be recovered from the solution.

144. "Optically active reduced naphthoic acids. Part II. The resolution of the tetrahydronaphthoic acids." By Robert Howson Pickard and Joseph Yates.

1 : 2 : 3 : 4-Tetrahydro-1-naphthoic acid and 1 : 2 : 3 : 4-tetrahydro-2-naphthoic acid have each been resolved into their optical antipodes by the fractional crystallisation from acetone of the *l*-menthylamine salts.

The lævo-isomeride of the first has $[M]_D - 28{\cdot}1°$ in chloroform and $-92{\cdot}1°$ in benzene, that of the second having $[M]_D - 91{\cdot}2°$ in chloroform and $-87{\cdot}9°$ in benzene. The sodium salts when dissolved in water have respectively $[M]_D -21{\cdot}1°$ and $-90{\cdot}5°$.

145. "The velocity of chemical change in the pentamethylen series." By N. Menschutkin, sen.

The general results of the study of the velocity of chemical change in polymethylene derivatives are as follows:

(1) The formation of the closed polymethylene chain from an open saturated chain of normal structure proceeds with increase of velocity. The maximum increase occurs in the formation of the pentamethylene ring; in the case of the hexamethylene ring the increase is less, and the heptamethylene ring is formed with the minimum increase of velocity.

(2) The increase of velocity at the closing of the open chain is not a specific property of the polymethylene ring, but is a general phenomenon observed in the formation of all closed chains, alicyclic and heterocyclic.

(3) The constants of velocity decrease according as the number of methylene groups in the polymethylene rings increases. The decrease is of the same order as is observed in the homologous series of open chain saturated carbon compounds of normal structure.

(4) The secondary polymethylene alcohols, in which the hydroxyl group is attached to the carbon atom of the ring, are typical secondary alcohols. Their esterification constants are higher than those of the saturated secondary alcohols of normal structure. Hence, the polymethylene alcohols give higher constants than all of the secondary alcohols studied. The constants of the derivatives of *cyclo*pentanol are the highest; *cyclo*hexanol gives much lower values, and *cyclo*heptanol still less.

(5) The side chain combined with the carbon atom united with the hydroxyl group gives rise to the formation of the polymethylene tertiary alcohols. Their esterification constants are very low, but esterification proceeds regularly; this is not the case with saturated tertiary alcohols, but is characteristic of phenols.

(6) When the side chains are in the ortho- and diortho-positions, a great decrease in the esterification constants is observed. This effect, commonly ascribed to the benzene ring alone, is a general property of all classes of chains whether open or closed, and containing carbon or other elements.

(7) When the side chain is in the position 3 or 4 of the polymethylene ring, an increase of esterification constants is observed, so much so that in the hexamethylene series the value of the constant of the first member of the series is exceeded.

(8) This property is not confined to the polymethylene ring, but applies generally to ringed systems, alicyclic and heterocyclic. As open chain compounds show no such increase of velocity, this is an important character of the closed chains.

(9) When a hexamethylene ring is introduced into the open chain of an alcohol, the decrease of the esterification constant is much more than is effected by the benzene ring.

(10) Hexamethylene, like hexane, exerts a very considerable retarding influence when used as a solvent in these reactions.

146. "**Hydrolysis of ammonium salts by water.**"

By Ernest George Hill.

The author aspirated a measured volume of air through solutions of different ammonium salts, the strengths of the solutions being normal, fifth-normal, and twenty-fifth-normal. The ammonia passing over was absorbed in water, or, when the amount was large, in acid. In the first case, the ammonia was estimated from the conductivity of the solution; in the latter case, by titration. It was found that for strong acids the equation $\frac{C_{\text{Acid}} \times C_{\text{Base}}}{C_{\text{Salt}}} = K$, and for weak acids

$$\frac{C_{\text{Acid}} \times C_{\text{Base}}}{C^2_{\text{Salt}}} = K$$

holds good for the concentrations of salt used.

The constants obtained in the case of the salts of mono-basic acids are inversely proportional to the molecular conductivities of the acids, and agree well with the values obtained for the strength of the acids by the various dynamical methods. In the case of dibasic acids, the constants are irregular. It is shown that the constant must depend on both the first and second ionisation-coefficients of the acids.

The author described the method employed for estimating ammonia by taking the resistance of its solution in conductivity water and comparing this with the resistance curve of ammonia. The method gave good results with solutions containing from 0·00027 to 0·009 per cent.

147. "**The addition of alkyl halides to alkylated sugars and glucosides.**" **By James Colquhoun Irvine and Agnes Marion Moodie.**

When solutions of the equilibrium mixture of tetramethyl glucose in ordinary organic solvents are cooled from +20° to −20°, the specific rotations undergo very little alteration, and, on re-heating to the initial temperature, the values originally found for the rotatory powers are exactly duplicated. When, however, an alkyl halide is used as solvent, the specific rotation at first increases slightly with fall of temperature and then rapidly diminishes on further cooling. On re-heating the cooled solution to 20°, distinct downward multi-rotation was observed before the initial value was reached. The same regularities were shown by solutions of molecular proportions of the sugar and alkyl halides or hydrogen chloride in carbon tetrachloride.

The results point to the formation, during cooling, of oxonium compounds of the sugar with alkyl halides, and the α-form of the aldose appears to be more reactive than the β-isomeride. This was shown by a cycle of changes in specific rotation observed in the case of a solution in *iso*propyl iodide which had been cooled from 20° to 0°: (*a*) rapid decrease at 0°, due to oxonium formation; (*b*) subsequent upward multi-rotation at 0°, owing to the partial conversion, $\beta \longrightarrow \alpha$, in the uncombined sugar; (*c*) on re-heating to 20°, owing to dissociation of the oxonium compound, a rapid increase at constant temperature took place, followed by (*d*) downward multi-rotation at 20° to the initial value.

Tetramethyl α-methylglucoside also behaves abnormally when cooled in ethyl iodide solution, but the β-isomeride gives no indication of addition of the solvent. Comparable results were obtained with tetramethyl mannose and tetramethyl α-methylmannoside, but non-alkylated sugars or glucosides, when examined in mixtures of methyl alcohol and alkyl iodides, gave negative results.

The following notes have been received since the meeting:

148. "Note on the preparation of ethyl acetonedicarboxylate." By Ernest Ormerod.

In attempting to prepare ethyl acetonedicarboxylate, on fractionating the crude ester prepared by the method described by v. Pechmann (*Annalen*, 1891, **261**, 160) under reduced pressure, only a small quantity of volatile material was obtained, which on examination proved to be principally acetoacetic ester. The main product, which on cooling solidified to a white, crystalline mass, was ethylorcintricarboxylate.

Wolfman and v. Pechmann (*Ber.*, 1898, **31**, 2014) have shown that ethyl orcintricarboxylate is formed if an alcoholic solution of acetonedicarboxylic acid saturated with hydrogen chloride is allowed to stand for two or three weeks, and it was at first thought possible that the condensation had been brought about in this way during the preparation, but on examination it was found that the crude ester contained only a very small quantity of the orcinol derivative. It appeared very strange that the condensation should take place so readily, as according to Jerdan (Trans., 1899, **73**, 808) the pure ester may be heated at 180°

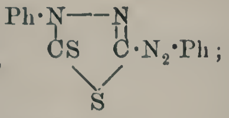
for a considerable time without any condensation taking place. Finally it was found that the condensation was brought about by the presence of a small quantity of calcium chloride which had been dissolved by the alcohol-ethereal solution of the ester. This view was shown to be correct by the fact that if the pure ester be heated with a trace of calcium chloride at 180° for a short time the amount of orcinol derivative formed corresponds to 4 per cent. of the theoretical. If the ethereal solution of the crude ester is dried over fused sodium sulphate, it may be distilled under reduced pressure without any condensation taking place.

During an attempt to prepare pure methyl acetonedicarboxylate, Dootson (Trans., 1900, 74, 1196) obtained a crude product which, on distillation under reduced pressure, condensed very readily to form methyl orcintricarboxylate, and he came to the conclusion that the methyl ester cannot be distilled without this condensation taking place. It seems improbable that the methyl ester should differ in this respect from the ethyl ester, and, although Dootson does not state how the ethereal solution was dried, it is probable that the crude ester contained some inorganic substance which promoted the condensation.

149. "The interaction of nitroformazyl, carbon bisulphide, and potassium hydroxide. A contribution to the chemistry of the thiobiazalones and the xanthates." By Ernest Ormerod.

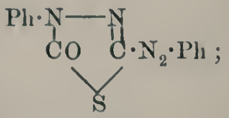
The peculiar position of the nitro-group in nitroformazyl confers on this compound very abnormal properties: thus, by the interaction of nitroformazyl, carbon bisulphide, and potassium hydroxide, three compounds are obtained:

1-*Phenyl-3-azophenyl dithiobiazalone*,



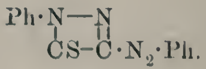
;

1-*phenyl-3-azophenyl thiobiazalone*,



;

and 1-*phenyl-3-azophenyl-2-thioaziethane*,



$$\begin{matrix} Ph\cdot N - N \\ CS - C\cdot N_2\cdot Ph. \end{matrix}$$

The three compounds are formed in varying quantities, depending on the solvent used and the conditions under which the experiment is carried out. Using alcohol as solvent, at the ordinary temperature the monothiobiazalone is almost exclusively formed, whilst if the interaction takes place at higher temperatures all three compounds are produced simultaneously; on using acetone or carbon bisulphide as the solvent, only the dithiobiazalone is formed.

The results obtained are interesting, as proving that a boiling alcoholic solution of carbon bisulphide and potassium hydroxide contains potassium xanthate, potassium dithiocarbonate, and potassium trithiocarbonate.

The author finds that the nitroformazyl is first reduced to formazylmercaptan, which is then acted on by the potassium xanthate, forming the dithiobiazalone, and by the potassium dithiocarbonate, forming the monothiobiazalone. The thioaziethane is apparently produced by the interaction of the potassium trithiocarbonate and the nitroformazyl.

The constitution of the biazalones obtained was proved by an examination of their decomposition products and by synthesis: the dithiobiazalone was synthesised from formazylmercaptan and thiophosgene, and the monothiobiazalone from formazylmercaptan and phosgene.

150. "Aldehydrol and the hydrates of compounds containing a carbonyl group." By William Morris Colles.

Concentrated aqueous solutions of aldehyde, acetone, formic, acetic, monochloroacetic, and trichloroacetic acids were cooled to low temperatures in an apparatus fitted with a combined filtering and stirring tube. The solutions, made up quantitatively in definite molecular proportions, were contained in a long, stoppered weighing tube into which the combined filtering and stirring tube fitted. This in turn was clamped inside a large vacuum vessel containing absolute alcohol, which, when cooled by liquid air, constituted the freezing mixture. Cooling was brought about very gradually and the solutions were very rapidly stirred. Several crystalline hydrates were obtained, the mother liquor being separated as soon as crystallisation had occurred. The following compounds of special interest were obtained: aldehydrol, $CH_3CH(OH)_2$, at $-90°$, a hydrol of formic acid, possibly *ortho*-formic acid, $HC(OH)_3$, *ortho*-acetic acid, $CH_3C(OH)_3$, and *ortho*-monochloroacetic acid, $CH_2ClC(OH)_3$. The analyses of the last two compounds, owing to experimental difficulties, were not very close. Acetone gave no result, and with trichloroacetic acid a hydrate containing 3 mols. of water was obtained. The hydrates of formic acid were fairly thoroughly investigated, and the following were obtained in a fairly pure crystalline condition: $CH_2O_2,4H_2O$, $4CH_2O_2,7H_2O$, $4CH_2O_2,3H_2O$, $3CH_2O_2.2H_2O$.

The next Ordinary Meeting will be held on **Thursday,** October **18th,** 1906, at **8.30** p.m., when the Longstaff Medal will be presented to Prof. W. N. Hartley, F.R.S.

LIST OF FELLOWS, 1906.

The List of Fellows for 1906 is now in active preparation, and changes of address received *after* 31*st July cannot be included in it.*

In order that the new list may be as complete as possible, those Fellows whose Degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

THE LIBRARY.

The Library will be closed for Stocktaking from **Monday, August 13th,** until **Saturday, August 25th,** 1906, inclusive.

Fellows are particularly requested to return all books belonging to the Library **not later than Wednesday, August 8th.**

ERRATUM.

PROCEEDINGS, 1906, p. 94.

In the list of Fellows who have resigned:
for "H. W. Lawrence" *read* "W. T. Lawrence."

CATALOGUE

OF

ALCHEMICAL AND EARLY CHEMICAL BOOKS

PRESENTED TO THE

CHEMICAL SOCIETY

BY

SIR HENRY ENFIELD ROSCOE, D.C.L., LL.D., F.R.S.

Accum, *Fredrick.* Description of the process of manufacturing coal gas, for the lighting of streets, houses, and public buildings, with elevations, sections, and plans of the most improved sorts of apparatus now employed at the gasworks in London. Second edition. 1820. 8o. pp. xvi + 334.

Agricola, *Georg.* De re metallica libri XII. Quibus officia, instrumenta, machinæ, ac omnia denique ad metallicam spectantia, non modò luculentissimè describuntur; sed & per effigies, suis locis insertas, adjunctis Latinis, Germanicisq́ue appellationibus, ita ob oculos ponuntur, ut clariùs tradi non possint. Quibus àccesserunt hâc ultimâ editione, Tractatus ejusdem argumenti, ab eodem conscripti, sequentes. De animantibus subterraneis. Lib. I. De ortu & causis subterraneorum. Lib. V. De natura eorum quæ effluunt ex terra. Lib. IV. De natura fossilium. Lib. X. De veteribus & novis metallis. Lib. II. Bermannus sive de re metallica, dialogus. Lib. I. Cum indicibus diversis, quicquid in opere tractatum est, pulchrè demonstrantibus. Basileæ, Sumptibus & typis. Emanuelis König. 1657. Folio. pp. [xiv] + 708 + [xcii].

Agrippa von Nettesheym, *Heinrich Cornelius.* De incertitudine & vanitate scientiarum & artium. Apud Elorentissimam Antuerpiam. 1534. 8o. ff. 160; pagination irregular.

Incomplete, wanting ff. 52—53.

—— Opera, in duos tomos concinne digesta, & nunc denuò, sublatis omnibus mendis, in φιλομούσων gratiam accuratissimè recusa. Quibus praeter omnes tabulas nouiter accessit ars notoria, quam suo loco interpositam reperies. Lugduni, Per Beringos Fratres. [1600.] 8vo. pp. [xxiv] + 668, [xvi] + 440 + [xvi]. [The *Epistolarum* are separately paged.] pp. 480.

Albertus Magnus. De secretis mulierū et virorum. *Colophon.* Impressum Liptzk per Melchiorem Lotter. Anno Millesimo q'ngentesimoquinto. [1505.] 4vo. ff. [xxx].

—— De mineralibus et rebus metallicis libri quinque. Coloniæ, apud Ioannem Birckmannum et Theodorum Baumium, 1569. 12o. pp. 391 + [xi].

Alchymist. Der von Mose. . . übel urtheilende Alchymist. See **Schmid,** *Johann George.*

Arnaldus de Villanova. Opera chymica: videlicet, Thesaurus Thesaurorum: seu Rosarius Philosophorum: ac omnium secretorum maximum secretum. Lumen nouum. Flos florum, & Speculum alchimiæ. Quibus nimirum artis huius mysteria etiam secretissima, luculenter enodantur, & quàm maxima licet, & potest fieri perspicuitate explicantur. Nunc primum ita coniunctim edita, opera & impensis, Hieronymi Megiseri. Francofurti, Typis Ioachimi Bratheringij. 1603. 8o. pp. 120. [The *Speculum* has a separate title-page and pagination.] pp. 80.

—— Chymische Schrifften, Darinnen begriffen. I. Der Schatz aller Schätze. II. Der philosophen Rosen-Garten. III. Das gröste Geheimnuss aller Geheimnüssen. IV. Spiegel der chymischen Kunst. Worbey zugleich mit angefüget. V. Die edle Practica der Prophetin Mariæ, Moysis Schwester. VI. Das Buch Calidis, des Sohns Jazichii, von den Geheimnüssen der Alchimie. VII. Kallid Rachaidibi, von den 3 Worten. VIII. Aristotelis Tractätlein, von der Practic des Philosophischen Steins. X. Ludus puerorum, das Kinder-Spiel und der Weiber-Arbeit. Allen Liebhabern der wahren Alchimie zu Gefallen aus dem Latein mit höchstem Fleiss in Teutscher Sprache übersetzet, Durch Johannem Hoppodamum. Franckfurt und Hamburg. In Verlegung Georg Wolffs, Buchhändlers in Hamburg, in St. Johannis Kirchen. 1683. 8o. pp. [xvi] + 350.

Aureum Vellus. *See* **Trissmosin,** *Salomon.*

Balduinus, *Christianus Adolphus.* Aurum superius & inferius auræ superioris & inferioris hermeticum. Amstelodami Apud Joannem Jansonium à Waesberge. 1675. 12o. pp. [xx] + 96. [Then follows the *Phosphorus hermeticus*, without pagination, pp. xiii.]

Barnaud, *Nicolas.* *See* **Ripley,** *George.*

Barth, *Jeremias.* *See* **Beguin,** *Jean.*

Batsdorff, *Heinrich von.* *See* **Reibehand,** *Christoph.*

Becher, *Johann Joachim.* Natur-Kündigung der Metallen. Mit vielen curiosen, Beweissthumben, natürlichen Gründen, Gleichnüssen, Erfahrenheiten, und bisshero ohngemeinen Auffmerckungen vor Augen gestellet. Zur Erhaltung der Warheit, Erläuterung der Spagirischen Philosophi, und Gefallen der Liebhabern. . . . In Verlegung Johan Wilhelm Ammons und Wilhelm Serlins. Franckfurt 1661. 8o. pp. [xiv] + 347 + [xxxvii].

Becher, *Johann Joachim.* Institutiones chimicæ prodromæ i.e. . . . Oedipus chimicus obscuriorum terminorum & principiorum chimicorum, mysteria aperiens & resolvens. Opusculum, omnibus medicinæ & chimiæ studiosis, lectu perquàm utile & necessarium. Francofurti, Apud Hermannum à Sande, 1664. 12o. pp. [xiv] + 192 + [viii].

—— Chymischer Glücks-Hafen, oder grosse chymische Concordantz und Collection, von funffzehen hundert Chymischen Processen: Durch viel Mühe und Kosten auss den besten Manuscriptis und Laboratoriis in diese Ordnung, wie hier folgendes Register aussweiset, zusammen getragen. Von Johann Joachim Becher . . . und . . . Paul Flemming. Franckfurt, In Verlegung Johann Georg Schiele, Buchhändlers, 1682. 4to. pp. [viii] + 810 + [xxxv].

Bound with **Ercker,** *L.* Aula Subterranea.

—— Chymisches Laboratorium oder unter-erdische Naturkündigung. Darinnen enthalten wird: I. Die tieffe Zeugung derer unter-erdischen Dinge: Wie auch der wunderbare Bau der ober- und unter-erdischen Erd- Wasser- und Lufft-Kugel: Und dann die absonderliche Natur der unter-erdischen Dinge Aufflöss- und Zerlegung in ihre Theile, und derselben Eigenschafft. II. Neue Chymische Proben, einiger künstlichen gleich darstelligen Verwandelung derer Metallen, nach Anleitung der in vorigen Jahren in Druck gegebenen Physicæ subterraneæ. III. Ein nochmaliger Zusatz und philosophischer Beweissthum̃, derer Chymischen, die Wahr- und Möglichkeit, derer Metallen Verwandelung in Gold, bestreitenden Lehr-Sätze. IV. Ein chymischer Rätseldeuter, derer verdunckelten Wört-Satze Urhebung und Geheimnüsse offenbahrend und aufflösend . . . Franckfurt, zu finden bey Philipp Fievet, Buchhändl. 1690.

Incomplete, Buch I: *Physica subterranea* only, pp. [xxviii] + 732.

—— Physica subterranea profundam subterraneorum genesin, è principiis hucusque ignotis, ostendens. Opus sine pari, primum hactenus & princeps, editio novissima. Præfatione utili præmissâ, indice locupletissimo adornato, sensuumque & rerum distinctionibus, libro tersius & curatius edendo operam navavit & Specimen Beccherianum, fundamentorum, documentorum, experimentorum, subjunxit Georg. Ernestus Stahl. Lipsiæ, Apud Joh. Ludov. Gleditschium. 1703. 8o. pp. [xxx] + 1008 + [xxxvi]. [pp. 655–6 and 823–832 omitted in pagination.] The *Specimen Beccherianum* has a separate title-page and pagination. pp. [viii] + 304 + xvi.

Becher, *Johann Joachim.* Mineralisches A B C. Oder vier und zwantzig chymische Theses von der Geburt, denen Principiis, Unterschied, Vermischung, und Auflösung deren Mineralien, Metallen, und übrigen Unterirrdischen Dingen, &c. Aus dem Lateinischen ins Teutsche übersetzet. Nun aber auf vieler Begehren zum Druck befördert durch Friederich Roth-Scholtzen. Nürnberg und Altdorff, bey Johann Daniel Taubers seel. Erben, Anno 1723. 8o. pp. 150.

Beguin, *Jean.* Tyrocinium chymicum . . . à Christophoro Glückradt, et Jeremia Barthio . . . Notis elegantibus illustratum, formulisq'; medicamentorum optimis & secretis locupletatum: Nunc verò à Johanne-Georgio Pelshofero. . . . Denuo, amicorum rogatu, in publicum emissum, ac triplici Indice ornatum. Wittebergæ, Impensis Andreæ Hartmanni, Bibliopol. Typis Johannis Röhneri, Acad. Typogr. 1650. 8o. pp. [liii] + 480 + [xliv].

—— Tyrocinium chymicum, commentario illustratum. A Gerardo Blasio. Editio secunda. Amstelodami. Apud Casparum Commelinum, 1669. 8o. [xxxvi] + 332 + [viii].

Berward, *Christian.* *See* **Ercker,** *Lazarus.*

Berzelius, *J. Jacob.* Die Anwendung des Löthrohrs in der Chemie und Mineralogie. Zweite Auflage. Nürnberg, 1828. 8o. pp. xvi + 282.

Black, *Joseph.* Lectures on chemistry. Edinburgh. [Manuscript, written after 1760]. 4 vols. 4o. pp. 379, 436, 388, 344.

—— Vorlesungen über die Grundlehren der Chemie aus seiner Handschrift herausgegeben von Johann Robison. Aus dem Englischen übersetzt und mit Anmerkungen versehen von Lorenz von Crell. Neue wohlfeile Ausgabe. Hamburg 1818. 4 vols. 8o. pp. cvi + 444 + [viii], 548 + [xiv], 484 + [x], 284 + [vi].

Boerhaave, *Hermann.* A new method of chemistry; including the theory and practice of that art: laid down on mechanical principles, and accommodated to the uses of life. The whole making a clear and rational system of chemical philosophy. To which is prefix'd a critical history of chemistry and chemists, from the origin of the art to the present time. . . . Translated from the printed edition, collated with the best manuscript copies. By P. Shaw, and E. Chambers. With additional notes and sculptures. London: printed for J. Osborn and T. Longman, at the Ship in Pater-noster-Row 1727. 4o. pp. xvi + 384, 335.

—— Elementa Chemiae, quae anniversario labore docuit, in publicis, privatisque, scholis, Hermannus Boerhaave. Qui continet historiam et artis theoriam. Cum tabulis aeneis. Lugduni Batavorum, sumptibus Joannis Rudolphi Im-Hoff, 1732. 4o. Vol. I [xii] + 896 + [lii]: (423–4 wanting); Vol. II [vi] + 538 + [xlv].

—— Anfangsgründe der Chymie praktischer Theil, aus dem Lateinischen übersetzt. Zwote Auflage, mit Anmerkungen von Johann

Christian Wiegleb. Danzig 1791. 8o. pp. [iv] + 476 + 270 + [xlviii].

Bollinger, *Ulrich.* *See* **Croll,** *Oswald.*

Bormes. Epitre a messieurs les savans et amateurs en chymie. Pour servir de réponse à un article des Elémens d'Histoire-Naturelle et de Chymie de M. de Fourcroy; suivie de plusieurs Mémoires, sur des opérations nouvelles et curieuses en chymie. A Bruxelles 1787. 8o. pp. [iv] + 145.

Bound with **Kirwan,** *Richard.* Essai sur le phlogistique, 1788.

Borrichius, *Olaus.* De ortu, et progressu chemiæ, dissertatio. Hafniæ, typis Matthiæ Godicchenii, sumptibus Petri Haubold, Reg. Acad. Bibl. 1668. 4o. pp. [xii] + 150 + [ii].

Boyle, *Robert.* Opera varia, quorum posthac exstat catalogus. Cum indicibus necessariis & multis figuris æneis. Genevæ, apud Samuelem de Tournes 1677.

A collection of 10 tracts, each having separate title-pages, signatures, and pagination.

Cassius, *Andreas.* De extremo illo et perfectissimo naturæ opificio ac principe terrænorum sidere auro de admirandâ ejus naturâ, generatione, affectionibus, effectis, atque ad operationes artis habitudine. Cogitata nobilioribus experimentis illustrata. Hamburgi, Sumptibus Georgii Wolffi, 1685. 8o. pp. [viii] + 152.

Chambers, *C.* *See* **Boerhaave,** *Hermann.*

Charleton, *Walter.* *See* **Helmont,** *Johann Baptista van.*

Colson, *Lancelot.* Philosophia Maturata: an exact piece of philosophy, containing the practick and operative part thereof in gaining the philosophers stone; with the wayes how to make the mineral stone, and the calcination of mettals. Whereunto is added, a work compiled by St. Dunstan, concerning the philosophers stone, and the experiments of Rumelius and preparations of Angelo Sala, all most famous chymists in their time. London, Printed for G. Sawbridge, and are to be sold at his house upon Clerken-well-Green, 1668. 24o. pp. [x] + 142.

Crell, *Lorenz von.* *See* **Black,** *Joseph.*

Croll, *Oswald.* Basilica Chymica continens. Philosophicam propriâ laborum experientiâ confirmatam descriptionem et usum remediorum chymicorum selectissimorum é lumine gratiæ et naturæ desumptorum. In fine libri additus est autoris ejusdem tractatus nouus de Signaturis Rerum internis. Cum gratia et priuilegio S. Cæs. Maiest: Francofurti, Impensis Godefridi Tampachij. (*No date.*) 4o. pp. [xvi] + 283 + [xxv]; Tractatus de Signaturis, pp. [xv] + 80 + [xvi]; Elegia de Vera Antiqua Philosophica Medicina, scripta à M. Ulrico Bollingero, etc., pp. 24.

This undated edition is a re-issue of that of 1609, with a new title-page. See **Ferguson,** *John,* Bibliotheca Chemica, Vol. I., p. 185.

Croll, *Oswald.* Basilica Chymica continens. Philosophicam propriâ laborum experientiâ confirmatam descriptionem et usum remediorum chymicorum selectissimorum é lumine gratiæ et naturæ desumptorum. In fine libri additus est autoris ejusdem tractatus nouus de Signaturis Rerum internis. Cum gratia et priuilegio S. Cæs. Maiest: Francofurti, Impensis Godefridi Tampachij. (*No date.*) 4o. pp. [viii] + 248 + xv. Then follows: Oswaldi Crollii Von Wetter auss dem Fürstenthumb Hessen, weyland Fürstlichen Anhaltischen wolverordneten Leib Medici Tractat von den jnnerlichen Signaturen, oder Zeichen aller Dinge . . . Getruckt zu Franckfurt am Mayn, bey Caspar Rötel, in Verlegung Gottfridt Tampachs. 1629. pp. 72 + 7.

The title-page to the *Basilica Chymica* is identical with that of the previous work; the book, however, is a German translation. The tract on signatures has a separate title-page and pagination.

Dorn, *Gerhard.* Congeries Paracelsicæ chemiæ de transmutationibus metallorum, ex omnibus quæ de his ab ipso scripta reperire licuit hactenus. Accessit genealogia mineralium, atq; metallorum omnium, eiusdem autoris. Gerardo Dorneo interprete. Francofurti Apud Andream Wechelum, 1581. 8o. pp. 277 + [i].

[Another copy.]

—— *See* **Paracelsus,** *Theophrastus.*

[**Dossie,** *Robert.*] Das geöfnete Laboratorium oder die entdeckten Geheimnisse der heutigen Chymisten und Apotheker welches viele besondere Dinge in sich enthält, die allen praktischen Aerzten zu wissen überaus nöthig sind. Aus dem Englischen übersetzt von George Heinrich Königsdörffer. Altenberg, 1760. Im Verlag der Richterischen Buchhandlung. 8o. pp. [xxxii] + 324 + [xii].

Englisches Klee-Blat, oder drey Elementen, Woraus Him̄el, Erden, Meere, mit allen ihren sichtbaren, hörbaren, fühlbaren, greiff und schmäckbaren Gestalten, bestehen. Durch fleissige Lesung Heil. Schrifft, und Englischer Bücher, Entdecket und Erwachsen. Neben denen Anweisungen Heil. Schrifft, und Meynungen der Weltweisen Ausgesetzet. Und der Königl. Preussischen Weltberühmten Societät der Wissenschafften zuförderst. Dann auch allen und jeden gelahrten und ungelahrten Liebhabern der irrdischen Wahrheiten zur ohnpartheischen, und Hochgeneigten Examinirung. Vom sichern Grund und helles Licht suchenden Authore Uberreichet. Gedruckt Anno 1709. 8o. pp. 40.

Bound with **Schmid,** *J. G.*, Der . . . Alchymist.

Erastus, *Thomas.* Disputatio de auro potabili, in qua accurate admodum disquiritur, num ex metallis, opera Chemiæ, concinnata pharmaca tutò utiliterque bibi possint. Basileæ. Apud Petrum Pernam, 1578. 8o. pp. [viii] + 24 + 148 + [xii].

Bound with **Schmid,** *J. G.*, Der . . . Alchymist.

Ercker, *Lazarus*. Aula Subterranea Domina Dominantium Subdita Subditorum. Das ist : Untererdische Hofhaltung, ohne welche weder die Herren regiren, noch die Unterthanen gehorchen können. Oder gründliche Beschreibung derjenigen Sachen, so in der Tieffe der Erden wachsen, als aller Ertzen der Königlichen und gemeinen Metallen, auch fürnehmster Mineralien, durch welche, nächst Gott, alle Künste, Ubungen und Stände der Welt gehandhabet und erhalten werden, da dann fürnemlich hierinn gelehret wird, wie sothanige Ertz- und Bergwercks-Arten, jede insonderheit ihrer Natur und Eigenschafft gemäss, auf alle Metalla probirt, und im kleinen Feuer versucht werden, nebst Erklärung einiger fürnehmer nutzlichen Schmeltzwercke im grossen Feuer, Item Ertz scheiden, puchen, waschen und rösten, auch Scheidung Goldes, Silbers, und anderer Metallen, ingleichem Kupffer saigern, Messing brennen, Salpeter sieden, destillation der Scheidwasser, und ihrem Brauch, auch zu Nutzmachung anderer mineralischen Berg- und Saltz-Arten. Anitzo aber, wegen Abgang der Exemplarien, aufs neue mit vielen nützlichen und nothwendigen Stücken und Secreten, so entweder Herr Ercker übergangen, oder nach der Zeit inventirt worden, und andern Notis über sel. Erckers Text mercklich vermehret, zusambt angehängter Auslegung der Terminorum und Red-Arten der Bergleute, Probirer, Wardeinen und Müntzmeister, deren sie sich, was ihre Profession belangt, zu bedienen pflegen. Ein sehr nützlich und nötig Werck für die Herren der Bergwercke, Berg-Rähte, Ertz- und Artzneykündiger, Probir-Discipeln, Laboranten, und alle, die mit Metallen und Mineralien umbgehen müssen oder wollen. Mit möglichstem Fleiss gestellet und ausgefertiget, durch einige hochverständige Bergwercks Erfahrne und Liebhabere. Franckfurt, In Verlegung Johann David Zunners, Buchhändlers. Druckts Johannes Haass, 1684. 4o. pp. [xiv] + 220 + 123 + [v]. [The *Interpres Phraseologiæ Metallurgicæ . . . zusammen getragen durch Christianum Berwardum* has a separate title and pagination.] 4o. pp. 68.

Bound with **Becher**, *J. J.*, Chymischer Glücks-Hafen.

Eröffnung der Thüre des Königlichen Pallasts, dass sie sey das rohe Antimonium und Materia Secunda Lapidis Philosophorum, welche vor denen mit Blindheit geschlagenen verdecket, und von denen Weisen unter doppelsinnigen Reden denen Unwürdigen verborgen gehalten worden, anjetzo aber auffs klärste durch gründliche Erweisung aller Welt wieder dargestellet wird durch einen Untersucher dieses vortreflichen Geheimnisses, der den Nahmen führet des Vorläuffers. Dressden und Leipzig, zu finden bey Gottfried Leschen, 1718. 8o. pp. [xvi] + 160.

Bound with **Hellwig**, *J. O.*, Arcana maiora.

Fabre, *Pierre Jean.* Hercules piochymicus . . . In quo penitissima, tum moralis philosophia, tum chymicæ artis arcana, laboribus Herculis, apud Antiquos tanquam velamine obscuro obruta deteguntur, & obuia fiunt et clausa omnia Philochymicis referantur. Tolosæ Tectosagum, Apud Petrum Bosc Bibliopolam, 1634. 8o. pp. [xvi] + 192.

Fanianus, *Johannes Chrysippus.* De arte metallicæ metamorphoseos liber singularis. Quo omnia, quæ ad philosophici lapidis opus pertinent, apertissimè describuntur. Item de jure artis alchemiæ veterum auctorum, & præsertim juris consultorum judicia et responsa ad quæstionem. An Alchemia sit ars legitima. Basileæ Apud Petrum Pernam, 1576. pp. [ix] + 118 (p. 24 omitted in pagination).

Bound with **Dorn**, *Gerhard*, Congeries Paracelsicæ Chemiæ.

Figuier, *Louis Guillaume.* L'Alchimie et les alchimistes, ou essai historique et critique sur la philosophie hermétique. Paris, 1854. 8o. pp. iv + 386.

Fourcroy, *Antoine-François de.* Tableaux synoptiques de chimie, pour servir de résumé aux leçons données sur cette science dans les écoles de Paris. Paris, An viii [1800]. Folio. pp. 11, and 12 double folio tables.

—— *See* **Bormes.**

Friedlibii, *Amadei.* *See* **Trium Virorum.**

Geber. Geberi des Königes der Araber, scharffsinnigen Philosophi und wahren Adepti Curieuse vollständige Chymische Schrifften, worinnen in den vier Büchern das Quecksilber, Schweffel, Arsenicum, Gold, Silber, Bley, Zinn, Kupffer, Eissen, &c., Oefen, Instrument, Sublimationen, Descension, Distillationen, Calcination, Solution, Coagulation, Fixation, Ceration, Test, Cement, Feurung, Schmeltzung, &c., ferner deren Anfänge, Præparationen, Essenzen, Saltze, Alaune, Atramente, Salpeter, Salarmoniac, Victriol, Antimonium, Bolus, Cinnober, Glass, Boras, Essig, &c., abgehandelt werden; wie auch das Testament, Güldene Buch der dreyen Wörter Kallid Rachaidibi, und andere Chymische Tractätgen, Summa, die gantze Kunst die unvollkommenen Metalle als Kupffer, Zinn, Bley, Eissen, &c., in Vollkommene, als Silber und Gold zu verwandeln, das ist: wie man Silber und Gold machen soll, enthalten, Alles aus einen Uhralten MSS. genommen, nach dem vorhandenen Exemplar in der Vaticanischen Bibliothec eingerichtet, mit gehörigen Figuren und Register versehen, und an Tag gegeben von Phileletha. Franckfurth und Leipzig, Verlegts Hieron. Philipp. Nitschel, Buchh. 1710. 8o. pp. [xvi] + 288.

Geissler, *Friedrich.* Baum des Lebens; das ist: Gründlicher Bericht vom wahrhafftigen Auro Potabili, wie ingleichen vom Wunderbahren Stein der Weisen, oder Grossen Elixir derer Philosophen &c., als der Höchsten AReZney. &c. . . . Auff Verlag Veit

Jacob Treschers, Buchändl. in Bresslau. Jena, druckts Joh. Nisius, 1683. 8o. pp. 64.

Bound with **Schmid**, *J. G.*, Der . . . Alchymist.

Girtanner, *Christoph.* Anfangsgründe der antiphlogistischen Chemie. Berlin, 1792. 8o. pp. x + 470 + [ii].

Glauber, *Johann Rudolf.* Furni novi philosophici, sive descriptio artis destillatoriæ novæ; nec non spirituum, oleorum, florum, aliorumque medicamentorum illius beneficio, facilimâ quâdam & peculiari viâ è vegetabilibus, animalibus & mineralibus, conficiendorum & quidem magno cum lucro; agens quoque de illorum usu tàm chymico quàm medico, edita & publicata in gratiam veritatis Studiosorum. Amsterodami, Prostant apud Joannem Janssonium 1651. 8o. Pars I, pp. 67 + [iii]; Pars II, pp. 148 + [iv]; Pars III, pp. 55; Pars IV, pp. 83 + [ii]; Pars V, pp. 54; Annotationes in appendicem, pp. 72.

—— De auri tinctura sive auro potabili vero. Quid sit & quommodo differat ab auro potabili falso & sophistico quomodo Spagyrice præparandum & quomodo in medicinâ usurpandum. Amsterodami, Prostant apud Joannem Janssonium 1651. 8o. pp. 22.

Bound with **Glauber**, *J. R.*, Furni novi philosophici.

—— Pharmacopœæ Spagyricæ. Pars Secunda. Amstelodami 1656. 8o. pp. 128.

—— Opera Chymica, Bücher und Schrifften, so viel deren von ihme bisshero an Tag gegeben worden. Jetzo von neuem mit Fleiss übersehen, auch mit etlichen neuen Tractaten vermehret, und umb mehrer Bequemlichkeit willen, in diese Form zusammen getragen, sampt ein darzu verfertigten vollkommenen Register. Franckfurt am Mäyn, In Verlegung Thomæ-Matthiæ Götzens. 1658. 4o. pp. [xxiv] + 574. Continuatio Operum Chymicorum . . . 1659. pp. [xii] + 444 + [xviii].

Glückradt, *Christopher.* *See* **Beguin**, *Johann.*

Hartmann, *George E.* *See* **Hartmann**, *Johann.*

Hartmann, *Johann.* Praxis Chymiatrica Johannis Hartmanni, Medicinæ Doctoris, et quondam Chymiatriæ in Academia Marpurgensi Professoris publici celeberrimi, & Principum Hassiæ Archiatri, edita â Johanne Michaelis, . . . et Georgio Euerharto Hartmanno, Authoris Filio. Lipsiæ, Sumptibus Gotofredi Grossii Bibliopolæ, 1633. 4o. pp. [xvi] + 238 (*should be* 246) + [xxx].

Heilmann, *John Jacob.* *See* **Theatrum Chemicum.**

Hellwig, *Johann Otto van.* Introitus in veram et inauditam physicam defensus per epistolam ad generosissimùm D.R.R. de St., &c., &c., à Matthia Scheffero. Francofurti, 1680. 12o. pp. 24.

Hellwig, *Johann Otto van.* Introitus in veram atque inauditam physicam. Heidelbergæ, 1680. 12o. pp. 87

Bound with **Hellwig**, *J. C. van*, Introitus . . . Francofurti, 1680.

—— Arcana maiora, oder curiöse und nützliche Beschreibung vieler wahrhaften physicalischen medicinischen, chymischen, alchymischen, chyrurgischen, und oeconomischen Geheimnisse. Aus Weltberühmter Leute, so wohl Indianischen Braminen oder Weltweisen, als auch Teutschen, Spanier, Italiäner, Engellender, Holländer, Dänen, Frantzosen, und anderer vortreflichen Männer Manuscriptis, und Correspondentzen auch eigener Erfahrung, auf seinen zwantzig jährigen weitläufftigen Reisen, mit sonderbaren Fleiss collegiret. Mit unterschiedlichen schönen raren Experimenten, Observationen, und Animadversionen vermehret. Auf inständiges Verlangen vieler (so wohl Hoher als Niedriger) Patronen und Freunden, nunmehro in Druck gegeben, auch mit nützlichen Figuren und nöthigen Registern versehen. Franckfurt und Leipzig, verlegts Michael Käyser, Buchhändler in Mühlhausen, 1717. 8o. Eröfnung I, pp. [xiv] + 78 + [ix]; II, 93 + [ix]; III, 73 + [iv]; IV, 103 + [ix]; V, [ii] + 70 + [viii]; VI, [ii] + 80 + [vi]; VII, ii + 71 + [vii] (68–69 omitted); VIII, [ii] + 54 (should be 55) + [vi]; IX, [ii] + 48 + [vi].

Helmont, *Johann Baptista van.* A Ternary of Paradoxes. The magnetick cure of wounds, the nativity of tartar in wine, the image of God in man. Translated, illustrated, and ampliated by Walter Charleton. London, printed by James Flesher for William Lee, dwelling in Fleet street, at the sign of the Turks head. 1650. 4o. pp. [lii] + 144 (pagination irregular).

—— Opera omnia. Additis his de novo tractatibus aliquot posthumis ejusdem authoris, maximè curiosis pariter ac perutilissimis, antehac non in lucem editis; una cum indicibus rerum ac verborum ut locupletissimis, ita et accuratissimis, Francofurti, Sumptibus Johannis Justi Erythropili. Typis Johannis Philippi Andreæ, 1682. 4o. pp. [xl] + 765 + [lxxiii]. Opuscula medica inaudita. pp. [xvi] + 275 + [xliii].

—— *See* **Rixner**, *T. A.*, and **Siber**, *T.*

Hermbstädt, *Sigismund Friedrich.* *See* **Scheele**, *Carl Wilhelm.*

Hollandus, *Johann Isaac.* Sammlung unterschiedlicher bewährter chymischer Schriften, namentlich: Hand der Philosophen, Opus Saturni, Opera vegetabilia, Opus minerale, Cabala, de Lapide Philosophico, Nebst einem Tractat von den Irrgängen derer Alchymisten, Auctoris incerti, neue und verbesserte Auflage, mit gehörigem Fleise übersehen, und mit einem Verzeichnüs derer in jeglichem Tractat befindlichen wichtigsten Materien vermehret wie auch mit nöthigen Kupffern gezieret. Wien In Verlag bey Joh. Paul Krauss, Buchhändler, 1746. 8o. pp. [xvi] + 762. [pp. 129–138 omitted in pagination, and 224–225 duplicated.]

Hollandus, *Johann Isaac*. *See* **Stahl**, *Georg Ernst*.

Hoppodamus, *Johannes*. *See* **Arnaldus de Villa Nova**.

Johannes de Padua. *See* **Schaubert**, *Johann*.

Johnson, *William*. Lexicon chymicum. Cùm obscuriorum verborum, et rerum hermeticarum, tum phrasium Paracelsicarum, in scriptis ejus; et aliorum chymicorum, passim occurrentium, planam explicationem continens, Londini, Excudebat G. D. impensis Gulielmi Nealand, apud quem prostant venales sub Signo Coronæ, in vico vulgò vocato, Duck Lane, 1657. 8o. pp. [xii] + 228.

Jugel, *Johann Gottfried*. Freyentdeckte Experimental-Chymie, oder Versuch den Grund natürlicher Geheimnisse durch die Anatomie und Zerlegungskunst, in dem astralischen, animalischen, vegetabilischen und mineralischen Reiche durch systematische Grundsätze, Lehrsätze, Beweise, Gegensätze, Gegenbeweise, Anmerkungen, Versuche, Erfahrungen und darauf folgende Schlüsse, nebst dem deutlichen Naturbegriffe der metallischen Generation, wie solche täglich in der Erde getrieben wird, durch eine lange Untersuchung, also vorzustellen, dass es ein jeder Naturforschender einsehen und erkennen kann; In zwey Theile abgefasset, und zu jedermanns Nutzen und Vergnügen dem Drucke überlassen. Leipzig, verglegts Johann Paul Krausse, Buchhändler, 1766. 8o. pp. [xiv] + 368. [pp. 209–214 are not numbered.]

Karsten, *Wenceslaus Johann Gustav*. Physisch-chymische Abhandlungen durch neuere Schriften von hermetischen Arbeiten und andre neuere Untersuchungen veranlasset. Halle im Magdeburgschen in der Rengerschen Buchhandlung, 1786. 8o. Heft I, pp. 208; Heft II, [iv] + 154.

Keiling, *George*. *See* **Trium Virorum**.

Kelley, *Edward*. Tractatus duo egregii, de lapide philosophorum, una cum theatro astronomiæ terrestri, cum figuris, in gratiam filiorum hermetis nunc primum in lucem editi, curante J. L. M. C. Hamburgi. Apud Gothofredum Schultzen. Anno 1676. 8o. pp. 125.

Khunrath, *Heinrich*. Amphitheatrum Sapientiæ Æternæ Solius Veræ, Christiano-Kabalisticum, Divino-Magicum, nec non Physico-Chymicum, Tertriunum, Catholicon: instructore Henrico Khunrath Lips: Theosophiæ amatore fideli, et Medicinæ utriusq́; Doct: Hallelu-Iah! Hallelu-Iah! Hallelu-Iah Phy diabolo! E Millibus Vix Vni. Anno M.D.C.II. Cum Privilegio Cæsareæ Majest: ad Decennium A Prima Impressionis Die. *Colophon:* Hanoviæ Excudebat Guilielmus Antonius, MDCIX. Folio. pp. [iv] + 60 + 222 + [i], [10 engraved symbolic plates, not included in the pagination].

Kircher, *Athanasius.* Ars magna lucis et umbræ, in X. libros digesta. Quibus admirandæ lucis & umbræ in mundo, atque adeò universa natura, vires effectusque uti nova, ita varia novorum reconditiorumque speciminum exhibitione, ad varios mortalium usus, panduntur. Editio altera priori multò auctior . . . Amstelodami, Apud Joannem Janssonium à Waesberge, & Hæredes Elizæi Weyerstraet, 1671. Folio. pp. [xxxii] + 810 (should be 710, pp. 424–525 having been omitted in pagination) + [ix].

—— Mundus Subterraneus, in XII libros digestus; quo divinum subterrestris mundi opificium, mira ergasteriorum naturæ in eo distributio, verbo *παντάμορφον* protei regnum, universæ denique naturæ majestas & divitiæ summa rerum varietate exponuntur. Abditorum effectuum causæ acri indagine inquisitæ demonstrantur, cognitæ per artis & naturæ conjugium ad humanæ vitæ necessarium usum vario experimentorum apparatu, necnon novo modo & ratione applicantur. Editio tertia, ad fidem scripti exemplaris recognita, & prioribus emendatior: tum ab Auctore Româ submissis variis observationibus novisque figuris auctior. Amstelodami, Apud Joannem Janssonium à Waesberge & Filios, 1678. Folio. pp. [xviii] + 366 + [vi]. [x] + 507 + [ix].

Kirwan, *Richard.* Essai sur le phlogistique, et sur la constitution des acides, traduit de l'anglois de M. Kirwan; avec des notes de MM. de Morveau, Lavoisier, de la Place, Monge, Berthollet, et de Fourcroy. A Paris, 1788. 8o. pp. xii + 344 + [iv].

Kleyn Distillierbüch. Ein newer und leichter Underricht, Künstliche Distillier öfen zumachen, alle Kreutter zubrennen, und warzü ein iedes Distilliert wasser güt zunützen. Franckfurt Chri. Ege. *Colophon:* Zu Strassburg bei Christian Egenolphen, Im Augst, Des M.D. und XXX. Jars. 4o. ff [iv] + xxvi.

Kunckel, *Johann.* Chymische Anmerckungen: darinn gehandelt wird von denen principiis Chymicis, Salibus Acidis und Alkalibus, Fixis und Volatilibus, in denen dreyen Regnis, Minerali, Vegetabili und Animali; wie auch vom Geruch und Farben, &c. Mit Anhang einer chymischen Brille contra Non-Entia Chym. Nach eigener Experientz beschrieben, mit unterschiedenen Experimentis bewähret, und denen Warheit- und Kunst-Liebenden zu Nutz und Dienstlichen Gefallen in den Druck befördert. Wittenberg, In Verlegung Job Wilhelm Fincelii seel. Erben, Druckts Christian Schrödter, 1677. 8o. pp. [xiv + 192].

—— V. Curiose Chymische Tractätlein; als: I. Chymische Anmerckungen, darinn gehandelt wird von denen Princip. Chym. Sal. Acid. & Alcalibus; Fixis & Volatilib. in denen 3 Regnis; wie auch vom Geruch und Farben &c. mit Anhang einer Chymischen Brille, contra Non-Entia Chym. II. Nützliche Observa-

tiones von den Fixen und flüchtigen Saltzen, Auro & Argento Potabili; Spiritu Mundi u. d. g. wie auch von den Farben und Geruch der Metallen, Mineral. &c. III. Epistola, contra Spiritum Vini sine Acido. IV. De Phosphoro Mirabili; dessen leuchtenden Wunder-Pilulen; sampt einem Discurs vom Nitro. V. Probier-Stein, de Acido & Urinoso, Sale Calido & Frigido; contra Herrn D. Voigts Spir. Vini Vindicatum. Wobey zugleich angehänget wird: Christoph Brummets Tractätlein vom Blut der Natur. Nebst einer Vorrede . . . D. Johannis Philippi Burggravii. Franckfurth und Leipzig, 1721. 8o. pp. [xii] + 512 + [xlviii].

[Another copy.]

Kunckel, *Johann.* Ars Vitraria Experimentalis, oder vollkommene Glasmacher-Kunst, lehrende, als in einem, aus unbetrüglicher Erfahrung, herfliessendem Commentario, über die von dergleichen Arbeit beschriebene sieben Bücher P. Anthonii Neri, von Florenz, und denen darüber gethanen gelehrten Anmerckungen Christophori Merotti . . . (so aus den Italien und Lateinischen beyde mit Fleiss ins Hochteutsche übersetzt) . . . Samt einem II Haupt-Theil . . . Alles hin und wieder in dieser dritten Edition um ein merckliches vermehret. Nürnberg, 1743. 4o. pp. [xii] + 472 + [xx].

—— *See* **Neri,** *Antonio.*

Kunst- und Werck-Schul. Wieder Neu aufgerichtete und vergrösserte in Zwey Theilen angewiesene curieuse Kunst- und Werck-Schul, deren Erster Theil meistens allerley Erdenckliche, nutzlich- und bewehrte Feuer-Künste vorstellet: Als I. Die wahre Erkäntnus der Ertzen und Metallen . . . II. Die schöne Form-Kunst, Bereitung guter Feuer-beständiger Haffner-Geschirr, als Oefen, Tiegel, etc. . . . III. Allerhand schöne Glas-Künste, wie man schönes Crystallen . . . IV. Von denen natürlichen Edelgesteinen . . . V. Allerley schöne ungemeine Chymische Secreta und Medicinalia . . . Ein Werck so allen Kunstliebenden dienlich und nutzlich, mit grosser Müh und Fleiss zusam̃engetragen selbst sehr viel davon experimentirt, und endlichen aus Christlicher Liebe mit getheilet und am Tage gegeben durch J. K. sonderbaren Liebhaber der Edlen Chymiæ und anderer natürliche Kunst- und Wissenschafften. Nürnberg, in Verlegung Johann Ziegers, Buchhändlern, 1705. 4o. pp. [vi] + 1357 + [lvii].

Le Febure [*Nicolas*]. A compleat body of chymistry: teaching the whole practice thereof by the most exact preparation of animals, vegetables and minerals, preserving their essential vertues. By Nicasius le Febure. . . . Rendered into English by P. D. C. London, printed by Tho. Ratcliffe for Octavian Pulleyn Junior, and are to be sold at the sign of the Bible in St. Pauls Church-yard near the little North-door, 1664. 4o. Part I, pp. viii + 312 + [vii]; Part II pp. [ii] + 364 + [viii].

The title-page to part I is missing, the above title-page being that of part II.

Lemery, *Nicolas.* Cours de chymie, contenant la manière de faire les opérations qui sont en usage dans la médecine, par une méthode facile. Avec des raisonnements sur chaque opération, pour l'instruction de ceux qui veulent s'appliquer à cette science. Troisieme edition. Paris, 1679. 8o. pp. [xxx] + 659 + [xv].

—— A course of chymistry, containing an easie method of preparing those chymical medicins which are used in physick. With curious remarks and useful discourses upon each preparation, for the benefit of such as desire to be instructed in the knowledge of this art. The third edition, translated from the eighth edition in the French, which is very much enlarged beyond any of the former. London, printed by R. N. for Walter Kettilby, at the Bishop's Head in S. Paul's Church-yard, 1698. 8o. pp. [xxviii] + 815 + [xvi].

[**Lenglet Dufresnoy,** *Nicolas.*] Histoire de la philosophie hermetique. Accompagnée d'un Catalogue raisonné des écrivains de cette science. Avec le véritable Philalethe, revû sur les originaux. Paris 1742. 3 vols., 12o. pp. xxiii + 486 + xx; xxxii + 120 + 360; [xxii] + 432.

Lewinstein, *Gustav.* Die Alchemie und die Alchemisten. (Sammlung gemeinverständlicher wissenschaftlicher Vorträge, herausgegeben von Rud. Virchow und Fr. v. Holtzendorff. V. Serie, Heft 113.) Berlin, 1870. 8vo. pp. 36.

Libavius, *Andreas.* Alchymia Andreæ Libavii, recognita, emendata, et aucta, tum dogmatibus & experimentis nonnullis; tum commentario medico physico chymico: qui exornatus est variis instrumentorum chymicorum picturis; partim aliunde translatis, partim planè nouis: In gratiam eorum, qui arcanorum naturalium cupidi, ea absq; inuolucris elementarium & ænigmaticarum sordium, intueri gaudent. Francofurti, Excudebat Joannes Saurius, impensis Petri Kopffi. 1606. Folio. pp. [xx] + 196 + xii. Commentariorum . . . Pars Prima. pp. [x] + 402. Pars Secunda. pp. 192 + [x].

—— Syntagmatis selectorum undiquaque et perspicue traditorum Alchymiæ Arcanorum, Tomus primus. In quem congesta sunt commentaria Chymiæ hactenus desiderata: Insertis passim scholijs, & commentationibus ipsis, ad penitissima huius philosophiæ & medicinæ ducentibus. Conscriptus et in IIX libros digestus. Francofurti Excudebat Nicolaus Hoffmannus, Impensis Petri Kopffii, 1615. Folio. pp. [xi] + 480 + [vii] . . . Tomus Secundus. In quem congesta sunt partim noua, eaq; penitiora Spagyrorum secreta, partim prioris tomi nonnulla explicatius tradita, & inter ea etiam ænigmatica Quercetani,

aliorumque Hermeticorum non pauca studiosè inuestigata, declarata & iudicata. . . . . Cum Indice copioso duplici, Chymico & Medico. Francofurti . . . 1613. pp. [xii] + 453 + [xiv].

Lullius, *Raymundus*. Illuminati sacre pagine pfessoris amplissimi magistri Raymundi Lull. ars magna, generalis et ultima: quarūcunqʒ artium ⁊ scientiarum ipsius Lull. assecutrix et clauigera: ⁊ ad eas aditum faciliorē prebēs: antehac nusq̄ʒ arti impressorie emūcrius cōmendata: ⁊ per magistrum Bernardum la Vinheta artis illius fidelissimū interpretē elimata. Una cum figuris suo situ decenter intextis ⁊ totius operis enucleatiuis. Incertis preterea cuilibet parti, capitulo et rubrice, titulis et annotationibus: adiecto indice alphabetico siue repertorio, sententias electiores cōplectente: ad folia remissiuo. *Colophon* . . . . Lugduni per Jacobum Marechal calcographum: sumptibus vero Simonis Vincent . . . 1517. 8o. ff. [iv] + 124.

—— Testamentum, duobus libris universam artem chymicam complectens antehac nunquam excusum. Item eiusdem compendium animæ transmutationis artis metallorum, absolutum iam & perfectum. Coloniæ Agrippinæ, Apud Ioannem Byrckmannum, 1566. 8o. ff. [iv] + 240 + [viii] (wanting f. 24).

—— Codicillus seu vade mecum. Coloniæ 1572. 8o. pp. 248.

—— Libelli aliquot chemici: [Testamentum novissimum; Elucidatio vocabulorum; Vade mecum; Compendium de transmutatione animæ metallorum; De compositione gemmarum; Epistola accurtatoria ad regem Neapolitanum; Medicina magna; Dialogus Demogorgon.] Basileæ, Apud Petrum Pernam, 1572. 8o. pp. [xvi] + 480 + [xxxi].

—— Libelli aliquot chemici. Basileæ, Typis Conradi Waldkirchii, 1600. 8o. pp. [xii] + 393 + [xxvi].

—— Aureumsane opus, in quo ea omnia breviter explicantur, quæ scientiarum omnium Parens, tam in scientiarum Arbore, q̃ʒ arte generali tradit. Autore Valerio de Valeriis Patricio Veneto, & scientiarum amatore, 1589. Augustæ vindelicorum imprimebat Michaël Manger. 4o. pp. [viii] + 179.

Manget, *Jean Jacques*. Bibliotheca chemica curiosa, seu rerum ad alchemiam pertinentium thesaurus instructissimus: quo non tantùm artis auriferæ, ac scriptorum in ea nobiliorum historia traditur; lapidis veritas argumentis & experimentis innumeris, immò & juris consultorum judiciis evincitur; termini obscuriores explicantur; cautiones contra impostores, & difficultates in tinctura universali conficienda occurrentes, declarantur: Verùm etiam tractatus omnes virorum celebriorum, qui in magno sudarunt elixyre, quique ab ipso Hermete, ut dicitur, Trismegisto, ad nostra usque tempora de chrysopoea scripserunt, cum præcipuis suis commentariis, concinno ordine dispositi exhibentur. Ad quorum omnium illustrationem additæ sunt quamplurimæ figuræ

æneæ. Coloniæ Allobrogum, Sumpt. Chouet, G. De Tournes, Cramer, Perachon, Ritter, & S. De Tournes. 1702. 2 vols., folio. pp. [xx]+938, [ii]+904.

A full list of the contents of this work is given in **Bolton**, *H. C.*, Bibliography of Chemistry, pp. 1005–1013, and **Ferguson**, *J.*, Bibliotheca Chemica, Vol. II, pp. 68–70.

Merrett, *Christopher*. *See* **Kunckel**, *Johann*.

—— *See* **Neri**, *Antonio*.

Meurdrac, *Maria*. Die Mitleidende und leichte Chymie dem löblichen Frauen-Zimmer zu sonderbahrem Gefallen in Frantzösischer Sprach beschrieben durch Jungfr. Maria Meurdrac, und nunmehr in Teutsch übersetzt und heraussgegeben von J. L. M. C. Sampt einem Tractätlein, wie man allerhand wohlriechende Sachen künstlich præpariren sol, durch Johann Muffatz. Franckfurt, In Verlegung Joh. David Zunners, 1673. 12mo. pp. [viii]+411+[xxv].

Michaelis, *Johann*. *See* **Hartmann**, *Johann*.

Musaeum Hermeticum Reformatum et Amplificatum, omnes sophospagyricae artis discipulos fidelissime erudiens, quo pacto summa illa veraque Lapidis Philosophici Medicina, qua res omnes qualemcunque defectum patientes, instaurantur, inveniri et haberi queat. Continens Tractatus Chimicos XXI. præstantissimos, quorum nomina et seriem versa pagella indicabit. In gratiam filiorum doctrinae, quibus Germanicum idioma ignotum est, Latina lingua ornatum. Francofurti et Lipsiae, 1749. 4o. pp. [xii]+862+[i].

A list of the contents of this work is given in **Ferguson**, *J.*, Bibliotheca Chemica, Vol. II, p. 119.

Neri, *Antonio*, **Merrett**, *Christopher*, and **Kunckel**, *Johann*. Art de la verrerie, de Neri, Merrett et Kunckel. Auquel on a ajouté le Sol sine veste D'Orschall; l'helioscopium videndi sine veste solem chymicum; le Sol non sine veste; le chapitre XI. du Flora Saturnizans de Henckel, sur la vitrification des végétaux; un mémoire sur la maniere de faire le saffre; le secret des vraies porcelaines de la Chine & de Saxe . . . Traduits de l'Allemand, par M. D * * * Paris 1752. 4o. pp. [iv]+lv+630+[ii].

Paracelsus, *Theophrastus*. Dess hocherfahrnesten Medici Aureoli Theophrasti Paracelsi schreyben, von den kranckheyten, so die vernunfft berauben, als da sein S. Veyts Thantz, Hinfallender siechtage, Melancholia vnd Vnsinnigkeit, &c., sampt ihrn warhafften curen. Darzu auss gemeldts Authoris Büchern gethan sein etliche lustige und nutzbare Process, Administrationes und würckungen dess Vitriols und Erdenhartzes, in rechter treuw publiciert, durch Adamum von Bodenstein . . . Innhalt und frucht dieses Buchs wird in der ersten Vorrede ordenlich begriffen. (Basilee) 1567. 4o. ff. [58]. [Sig. *, A—O_2; g.1. missing.]

Paracelsus, *Theophrastus.* Aurora Thesaurusque Philosophorum, Theophrasti Paracelsi, Germani Philosophi, & Medici præ cunctis omnibus accuratissimi. Accessit Monarchia Physica per Gerardum Dorneum, in defensionem Paracelsicorum Principiorum, à suo Præceptore positorum. Præterea Anatomia uiua Paracelsi, qua docet autor præter sectionem corporum, & ante mortem, patientibus esse succurrendum. 1577. Basilae. 8o. pp. 63.

Bound with **Dorn,** *Gerhard,* Congeries Paracelsicæ, &c., 1581.

—— Aureoli Theophrasti Paracelsi de summis naturæ mysteriis commentarij tres, à Gerardo Dorn conuersi, multóque quàm antea fideliter characterismis & marginalibus exornati, auctique. Quorum nomina sequens pagella dabit. Basileæ, Ex Officina Pernæa per Conr. Vvaldkirch, 1584. 8o. pp. [xvi] + 173 [should be 149] + x [pagination irregular].

—— Opera omnia medico-chemico-chirurgica, tribus voluminibus comprehensa. Editio novissima et emendatissima, ad Germanica & Latina exemplaria accuratissimè collata: Variis tractatibus & opusculis summâ hinc inde diligentiâ conquisitis, vt in voluminis primi præfatione indicatur, locupletata: Indicibusq́; exactissimis instructa. Genevæ, Sumptibus Ioan. Antonij, & Samuelis De Tournes. MDCLIIX. Vol. I, pp. [xxxiv] + 828 + [xxxix]; Vol II, [xxii] + 718 + [xxxii]; Vol. III, [xii] + 212 + [xxvii]; Vol. III, Sect. II, [iv] + 119 + [vii]. Testamentum, Dictionariolum, &c., 18.

—— Chymischer Psalter, oder Philosophische Grundsätze vom Stein der Weisen Anno 1522. Aus dem höchst seltenen lateinischen Grundtext übersetzt, von einem Liebhaber natürlicher Geheimnisse. Amsterdam, 1771. 8o. pp. [xvi] + 32.

—— *See* **Dorn,** *Gerhard.*

—— *See* **Thurneisser,** *Leonhart.*

—— *See* **Trissmosin,** *Salomon.*

Porta, *Giovanni Baptista.* Magiæ Naturalis libri viginti. Ab ipso quidem authore ante biennium adaucti, nunc verò ab infinitis, quibus editio illa scatebat mendis, optimè repurgati: in quibus scientiarum naturalium diuitæ & deliciæ demonstrantur. Accessit index, rem omnem dilucidè repræsentans copiosissimus. Librorum ordinem, qui in hoc opere continentur, versa pagina indicabit. Francofurti apud Andræ Wecheli heredes, Claudium Marnium, & Ioann. Aubrium. 1591. 8o. pp. [xxxvi] + 669.

—— La magie naturelle: qui est, les secrets & miracles de Nature, mise en quatre livres, par Iean Baptiste Porta Neapolitain. Nouvellement traduite de Latin François. Rouen 1606. 8o. ff. [vii] + 278 + [xvii].

—— Magia naturalis, oder Haus-Kunst- und Wunder-Buch. Zu erst von dem selben Lateinisch beschrieben; hernach von Ihm selbst

vermehret; nunmehr aber allen Liebhabern der natürlichen Wissenschafften zum besten, nicht nach dem alten Druck, der Frantzösischen und Teutschen Edition, darinnen nur vier Bücher; sondern durch alle zwantzig Bücher gantz aufs neu in die Hochteutsche Sprache übersetzet; von allen Fehlern, so in dem Lateinischen Druck, mit grossem Hauffen übrig geblieben, und aufs neue eingeschlichen, aufs fleissigste gereiniget; in gewisse mit Zahlen unterschiedene Absätze abgetheilet; mit deutlichen Teutschen Kunst-reimen gezieret; an Figuren gebessert, mit schönen Kupfern geschmücket; mit nothwendigen Anmerckungen und Auflösungen der darinn enthaltenen Rätzel, wie auch vielen neuen ungemeinen guten Chymischen und andern Stücken vermehret, auch mit guten Registern versehen, und in zweyen Theilen, deren das erste, die ersten sieben; das andre die letzten dreyzehen Bücher in sich enthält, heraus gegeben durch Christian Peganium, sonst Rautner genannt. Nürnberg, in Verlegung Johann Ziegers Buchhändlers. Gedruckt zu Sultzbach durch Abraham Liechtenthaler, 1680. Erste Buch. 8o. pp. [x] + 990 + [cxiv] [pp. 1–2 and 15–16 missing; the latter are supplied in manuscript]. Zweite Buch. pp. [i] + 876 + [xxxvi] [pp. 847–848 omitted in pagination].

Rebentrost, *David*. *See* **Trium Virorum**.

[**Reibehand**, *Christoph.*] Filum Ariadnes das ist: Neuer chymischer Discurs von den grausamen und verführischen Irrwegen der Alchymisten, dadurch sie selbst und viel Leute neben ihnen verleitet werden, und dann, was doch endlich der rechte uhralte einige Weg zu dem allerhöchsten Secreto sey, wie darinnen zu procediren, und welcher gestalt auch particularia zur Hand gebracht werden können. Alles durch selbst-eigene Experientz erkläret und an Tag gegeben durch Heinr. von Batsdorff, Hermundurum. Denen sind noch beygefüget LXXIX. grosse und sonderbahre Wunder. So bey einem Special angegebenen Subjecto theils von der Natur, theils aber in der geführten Arbeit sich befunden haben. Gotha, Verlegts Jacob Mevius, 1718. 8o. pp. [xvi] + 136. [The *Grosse und sonderbahre Wunder* . . . 1725, has a separate title-page and pagination.] pp. 71.

Bound with **Valentinus**, *B.*, Chymische Schriften, 1740.

Ripley, *George*. Chymische Schrifften des hochgelehrten, fürtreflichen und weitberhümten Philosophi Georgii Riplæi, Canonici Angli. Darinnen vom gebenedeyeten Stein der Weisen und desselben kunstreicher præparation gründlich gelehret wird, Zuvor durch den Hochgelahrten Herrn Nicolaum Barnaudum Chymicum zu Lateinischer Sprache publiciret, Jetzo aber allen Filiis doctrinæ zum besten durch einen Liebhaber der Kunst in Deutsche Sprache gebracht, und in Druck gegeben Anno 1624. Gedruckt In verlegung Johann

Birckners, Buchhändlers in Erffurt. 8o. pp. [i] + 113 [should be 111, pagination irregular].

Rixner, *Thaddä Anselm,* and **Siber,** *Thaddä.* Leben und Lehrmeinungen berühmter Physiker am Ende des XVI und am Anfange des XVII Jahrhunderts, als Beyträge zur Geschichte der Physiologie in enigerer und weiterer Bedeutung. Heft VII. Joh. Bapt. v. Helmont. Sulzbach, 1826. 8o. pp. viii + 245 + [iii].

Robison, *Johann.* *See* **Black,** *Joseph.*

Rosencreutz, *Christian.* Chymische Hochzeit: Christiani Rosencreütz. Anno 1459. Arcana publicata vilescunt; & gratiam prophanata amittunt. Ergo: ne Margaritas obijce porcis, seu Asino substerne rosas. Strassburg, In Verlägung, Lazari Zetzners. 1616. *Colophon*: Strassburg, Gedruckt bey Conrad Scher, Im Jahr MDCXVI. 8o. pp. 146 + [ii].

Roth-Scholtz, *Friederich.* Deutsches Theatrum Chemicum, auf welchem der berühmtesten Philosophen und Alchymisten Schrifften, die von dem Stein der Weisen, von Verwandlung der schlechten Metalle in bessere, von Kräutern, von Thieren, von Gesund- und Sauer-Brunnen, von warmen Bädern, von herrlichen Artzneyen und von andern grossen Geheimnüssen der Natur handeln, welche bisshero entweder niemahls gedruckt, oder doch sonsten sehr rar worden sind. Nürnberg, bey Adam Jonathan Felsseckern 1728–1732. 3 vols., 8o. [ii] + 26 + [ii] + 680 + 32 + 350; 22 + 935; 46 + 960.

A full list of the contents of this work is given in **Bolton,** *H. C.*, Bibliography of Chemistry, pp. 1035–1040, and **Ferguson,** *J.*, Bibliotheca Chemica, Vol. II, pp. 298–299.

—— Bibliotheca Chemica. H. E. Collectio Auctorum fere omnium, qui de naturae arcanis, re metallica et minerali, item de melioratione corporum artificiali etc., Hermetice scripserunt. Recensentur etiam diversae librorum editiones aliaque huius generis manuscripta hactenus inedita. Fasciculus primus editio secunda. Norimbergae et Altdorfii apud Haeredes Joh. Dan. Tauberi. 1735. 8o. pp. 238.

—— *See* **Becher,** *Johann Joachim.*

[**Schaubert,** *Johann.*] Auszug aus des Joannis von Padua consum̄ata Sapientia oder Praxis von dem Mineralischen Stein. Franckfurt Anno 1681 in Duodez. Item daselbst aus d. Epistl Joannis Trithemii, item daselbst aus d. Epistl Joannis Teutz Schescheni, etc. [Manuscript.] 8o. pp. [ii] + 126.

The above consists of manuscript extracts from **Schaubert,** *Johann.* Consummata Sapientia, seu Philosophia Sacra, Praxis der Lapide Minerali, Johannis de Padua, Epistola Johannis Trithemii, Von den dreyen Anfängen aller natürlichen Kunst der Philosophiæ. Epistola Johann Teutzschescheni, De Lapide Philosophorum . . . Francofurti, 1681. 12o. pp. 282.

Scheele, *Carl Wilhelm.* Sämmtliche physische und chemische Werke, nach dem Tode des Verfassers gesammlet, und in deutscher Sprache herausgegeben von Sigismund Friedrich Hermbstädt. Berlin, 1793. 2 vols., 8o. pp. xxxii + 264, 446.

[**Schmid,** *Johann Georg.*] Der von Mose u. denen Propheten übel urtheilende Alchymist, wird fürgestellet in einer Schrifft-gemässen Erweisung, dass Moses und einige Propheten, wie auch David, Salomon, Hiob, Esra und dergleichen, keine Adepti Lapidis Philosophorum gewesen sind; Ingleichen dass die Lehre und alchymistisch Vorgeben, von Verwandlung der geringen Metalle in Gold, eine lautere Phantasie und schädliche Einbildung sey; Von einem Liebhaber der Wahrheit, der sich tröstet, dass der Allmächtige sein Gold sey, Hiob XX. v. 25. und nichts Jm Golde Sucht. Chemnitz, bey Conrad Stösseln, 1706. 8o. pp. [xiv] + 144.

Shaw, *Peter.* *See* **Boerhaave,** *Hermann.*

Siber, *Thaddä.* *See* **Rixner,** *Thaddä Anselm.*

Stahl, *Georg Ernst.* Zufällige Gedancken und nützliche Bedencken über den Streit, von dem so genannten Sulphure, und zwar sowol dem gemeinen, verbrennlichen, oder flüchtigen, als unverbrennlichen, oder fixen. Halle, In Verlegung des Wäysenhauses, 1718. 8o. pp. [viii] + 373.

—— Zymotechnia fundamentalis, oder allgemeine Grund-Erkänntniss der Gährungs-Kunst, vermittelst welcher die Ursachen und Würckungen dieser alleredelsten Kunst, welche den nutzbahrsten und subtilesten Theil der gantzen Chymie ausmacht. Aus den wesentlichen mechanisch-physischen Haupt-Gründen überhaupt mit höchstem Fleiss ans Licht gestellet, und mit einem neuen chymischen Experiment, wie ein wahrer Schwefel durch Kunst zum Vorschein zu bringen; wie auch mit andern nützlichen Erfahrungs-Proben und Anmerckungen dem Publico mitgetheilet werden. Wegen ihres unbeschreiblichen Nutzens aus dem Lateinischen ins Teutsche übersetzet. Franckfurth und Leipzig. Verlegts Johann Leopold Montag [in Regenspurg, 1734]. [Title-page cut down.] 8o. pp. [xxii] + 304.

—— Fundamenta chymiae dogmaticae et experimentalis, et quidem tum communioris physicae mechanicae pharmaceuticae ac medicae tum sublimioris sic dictae hermeticae atque alchymicae. Olim in privatos auditorum usus posita, jam vero indultu autoris publicae luci exposita. Annexus est ad coronidis confirmationem tractatus Isaaci Hollandi De Salibus et Oleis Metallorum. Editio secunda, emendatior et auctior. Norimbergae, impensis B. Guolfg. Maur. Endteri Consortii et Vid. B. Iul. Arnold Engelbrechti. 1746–7. 3 vols., 4o. pp. [viii] + 255 + [xxiii], [viii] + 76 + 199 + [31], [viii] + 508 + [xviii].

—— *See* **Becher,** *Johann Joachim.*

Sternhals, *Johann.* Ritter-Krieg das ist: Ein Philosophisch-Ge-

schicht, in Form eines gerichtlichen Processes, wie zwey Metallen, nemblich Sol und Mars, durch Klag, Antwort und Beweiss, jegliches Natur uñ Eigenschaft von ihrem näturlichen Gott und Richter ☿rio gehöret, und endlich durch ein wol-gegründetes Urtheil, mit ewigwahrender Freundschafft einig zusammen verbunden werden. Länger denn vor 200. Jahren durch den Ehr-Würdigen Herrn Johann Sternhals, damahls Catholischen Priester des Bischöfflichen Stiffts Bamberg, als einem wahren Chymico und Philosopho laut seiner eigenen Vorrede gestellet. Jtzo wieder auffs neu ubersehen und zum Druck heraussgegeben. Hamburg, In Verlegung George Wolff, Buchhändl. in S. Johañes-Kirchen, 1680. 8o. pp. [xii] + 96.

Bound with **Suchten,** *Alexander von,* Chymische Schrifften.

Suchten, *Alexander von.* Chymische Schrifften alle, so viel deren vorhanden, zum ersten mahl zusammen gedruckt, mit sonderbahrem Fleiss von vielen Druckfehlern gesäubert, vermehret, und in zwey Theile, als die Teutschen Lateinischen verfasset. Franckfurt am Mayn, In Verlegung Georg Wolffs, Buchh. in Hamburg, Druckts Johann Görlin. 1680. 8o. pp. [xiv] + 486 + [ix].

Teutzscheschen, *Johann.* *See* **Schaubert,** *Johann.*

Theatrum Chemicum, præcipuos selectorum auctorum tractatus de chemiæ et lapidis philosophici antiquitate, veritate, jure, præstantia, & operationibus, continens: In gratiam veræ chemiæ, & medicinæ chemicæ studiosorum (ut qui uberrimam inde optimorum remediorum messem facere poterunt) congestum, & in sex partes seu volumina digestum; Singulis voluminibus, suo auctorum et librorum catalogo primis pagellis: rerum verò & verborum indice postremis annexo. Argentorati, sumptibus Heredum Eberh. Zetzneri 1659–61. 6 vols., 8o. Vol. I, pp. 794 + [xxx]; Vol. II, 549 + [vii]; Vol. III, 859 + [xiii]; Vol. IV, [viii] + 1014 + [xxxiii]; Vol. V, [viii] + 912 + [xxix]. *Vol. VI has the following title*: Theatri Chemici volumen sextum, theologis, medicis, et tam vulgaribus quam hermeticæ, chemiæ studiosis utilissimum, præcipuos selectorum auctorum huius seculi tractatus de chemia & lapidis philosophici antiquitate, veritate jure præstantia & operationibus continens, ex Germanica & Gallica lingua in Latinam translatum per Johannem Jacobum Heilmannum, Argentorati, sumptib. Hæredum Eberhardi Zetzneri, 1661. pp. [xviii] + 772 + [xxv].

A full list of the contents of this work is given in **Bolton,** *H. C.,* Bibliography of Chemistry, pp. 1050–1058, and **Ferguson,** *J.,* Bibliotheca Chemica, Vol. II, pp. 436–439.

Thomson, *Thomas.* A system of chemistry. In four volumes. The second edition. Edinburgh. 1804. 8o. pp. xvi + 605, viii + 596, vii + 629, viii + 808.

—— An attempt to establish the first principles of chemistry by

experiment. In two volumes. London 1825. 8o. pp. xxiii + 478, vii + 532.

Thomson, *Thomas.* A system of chemistry of inorganic bodies. In two volumes. Seventh edition. London and Edinburgh, 1831. 8o. pp. ix + 944, viii + 742.

Thurneisser, *Leonhart.* Pison. Das erst Theil. Von Kalten, Warmen, Minerischen und Metallischen Wassern, sampt der vergleichunge der Plantarum und Erdgewechsen 10 Bücher: Durch Leonhart Thurneisser zum Thurn, mit grosser mühe und arbeit, gemeinem nutz zu gut an tag geben. Mit Röm. Kay. May. freyheit auff 10 Jar. 1572. Gedruckt zu Franckfurt an der Oder, durch Johan Eichorn. Folio. pp. [xx] + ccccxx + [liii].

—— : מֶלִיצָת KA`I 'EPMHNE'IA. Das ist ein Onomasticum und Interpretatio oder aussführliche Erklerung, Uber Etliche frembde uñ (bey vielen hochgelarten, die der Lateinischen und Griechischen Sprach erfahren) umbekante Nomina, Verba, Proverbia, Dicta, Sylben, Caracter, und sonst Reden. Deren nicht allein in des theuren Philosophi und Medici Aurelij, Theophrasti, Paracelsi von Hohenheim, Sondern auch in anderer Authorum Schrifften, hin und wider weitleufftig gedacht, welche hie zusammen, nach dem Alphabet verzeichnet. Das Ander theil. In welchem fast jedes Wort, mit seiner eigenen schrifft, nach der Völcker Etymologia oder eigenen art und weis zureden, beschrieben worden ist. Gedruckt zu Berlin durch Nicolaum Voltzen 1583. Folio. pp. [xii] + 188.

Bound with **Thurneisser,** *L.*, Vel Magna Alchymia.

—— ΜΕΓΑΛΗ ΧΥΜΙΑ, Vel Magna Alchymia. Das ist ein Lehr und unterweisung von den offenbaren und verborgenlichen Naturen, Arten und Eigenschafften, allerhandt wunderlicher Erdtgewechssen, als Ertzen, Metallen, Mineren, Erdsäfften, Schwefeln, Mercurien, Saltzen und Gesteinen. Und was der dingen zum theil hoch in den Lüfften, zum theil in der Tieffe der Erden, und zum theil in den Wassern, welche aus dem Chaos oder der Confusion, und vermischung Elementischer Substanzen, als Geistlicher, uñ doch subtiler, noch unbestendiger weis verursacht, empfangen und radicirt, Aber von Himelischer zuneigung der Influentischen impression, oder Eintruckung, Seelischer und Fixer oder bestendiger weise, zu einer wesentlichen materia digerirt, coagulirt, oder præparirt, Und durch die natürliche Vermögligkeit, Krafft und forthtreibung, jedes in seiner gestalt, Als ein greiffelichs, eintzigs, wesentlichs ding, Corporalischer, volkommener weise, von seiner Radice abgelöset, an tag aussgestossen, und in gestalt einer sichtigen Massæ geboren: Und wie, oder welcher gestalt, oder auff was weiss uñ wege, deren ein jedes, mit zusatz des andern, durch Menschlichen Handgriff, oder den Usum (dieser sehr alten Kunst) eintweders in ein Liquorem, Oehl, Saltz, Stein, Wasser, Schwefel, Mercurium oder andere Mineren und Metall verwandelt, oder sonst zum nutz, gebrauch und wolstandt, Menschlichs zeitlichs Lebens zugericht und bereitet wird. Gedruckt zu Berlin durch Nicolaum Voltzen. 1583. Folio. pp. [xii] + 144 + [xii].

Tiffereau, *C. Théod.* Die Golderzeugung auf künstlichem Wege ist thatsächlich erwiesen. Die Metalle sind keine einfachen, sondern zusammengesetzte Körper. Aus dem Französischen. Berlin, 1855. 8vo. pp. 29.

[**Trissmosin,** *Salomon.*] Aureum Vellus Oder Guldin Schatz und Kunstkamer: Darrinen der aller fürnemisten, fürtreffenlichsten, ausserlesenesten, herrlichisten und bewehrtestē Auctorum Schrifften und Bücher, auss dem gar vraltē Schatz der uberblibnen, verborgnen, hinderhaltenen Reliquien und Monumenten der Aegyptiorum, Arabum, Chaldæorum & Assyriorum Königen und Weysen. Von dem Edlen, Hocherleuchten, Fürtreffenlichen, bewertē Philosopho Salomone Trissmosino (so dess grossen Philosophi und Medici Theophrasti Paracelsi Præceptor gewesen) in sonderbare underschiedliche Tractätlein disponiert, und in das Teutsch gebracht. Sampt anderen Philosophischen alter unnd newer Scribenten sonderbaren Tractätlein, alles zuuor niemalen weder erhört noch gesehen, wie der Catalogus zuverstehen gibt. Durch einen der Kunst liebhabern mit grossem Rosten, Mühe, Arbeyt und Gefahr, die Originalia und Handschrifften zusammen gebracht, unnd auffs trewlichest und fleissigst an Tag geben. Getruckt zu Rorschach am Bodensee. 1598. 4o. Tract I, pp. [viii] + 117. Tract II, pp. [ii] + 102. Tract III, pp. 248 (Gg *is wrongly imposed*). [Hand-coloured woodcuts.]

A detailed list of contents is given in **Ferguson,** *J.*, Bibliotheca Chemica, Vol. II, p. 469.

Tritheim, *Johann.* *See* **Schaubert,** *Johann.*

Trium Virorum Chymicorum clarissimorum, nehmlich Amadei Friedlibii, Davidus Rebentrosts und Doctor George Keilings Collectanea curiosa de Bismutho, Das ist Etliche rare, biss anhero noch nie bekannt, sondern sehr geheim gehalten gewesene chymische Processe, Wovon auch bey denen Autoribus Chymicis nicht die allergeringste Meldung zu finden, Welche vorietzo allen Liebhabern der edlen Chymie als besondere Arcana und in der Praxi niemahls fallibel befundene Processe, durch den Druck communiciret worden. Dressden und Leipzig, bey Gottfried Leschen, 1718. 8o. pp. 88.

Bound with **Hellwig,** *Johann Otto*, Arcana maiora.

Trommsdorff, *Johann Bartholomäus.* Taschenbuch für Aerzte, Chemiker u. Pharmazeutiker auf das Jahr 1803. Erfurt. 8o. pp. [xxiv] + iv + 176.

Uhr-alter Ritter-Krieg, das ist, Ein Alchymistisch kürtzliches Gespräch unsers Steins, des Goldes und des Mercurij, von der wahren Materij, daraus der Stein der Weisen von den Naturkündigern durch gebührliche Handgriffe mit Hülffe des Lunischen Vulcani bereitet wird von einem alten wohlerfahrnen Philosopho beschrieben. Hamburg, In Verlegung Georg Wolffs, Buchändl. in S. Johañis-Kirchen, 1680. 8o. pp. 16.

Bound with **Suchten**, *Alexander von*, Chymische Schrifften, 1680.

Usufur womit ein vornehmer Italiänischer Fürst von einem vermeinten Chymico listiger Weise betrogen worden. Vor einigen Jahren Welsch, nun aber Teutsch publicirt. So als ein Anhang zum Fegefeuer der Chymisten dienen kan. Franckfurt und Leipzig, zu finden im Taubrischen Buchladen, 1717. 8o. pp. [24].

Bound with **Hellwig**, *Johann Otto*, Arcana maiora.

Valentinus, *Basilius.* Chymische Schriften alle, so viel derer verhanden, anitzo zum Ersten mahl zusammen gedruckt, auss vielen so wol geschriebenen als gedruckten Exemplaren vermehret und verbessert und in Zwey Theil verfasset. Hamburg, In Verlegung Johann Naumans und Georg Wolff, 1677. 8o. pp. [vi] + 446 + [xxiv], 400 + [xxviii].

—— Chymische Schriften, aus einigen alten MSten aufs fleissigste verbessert, mit vielen Tractaten, auch etlichen Figuren vermehret, und nebst einem vollständigen Register in drey Theile verfasset: Samt einer neuen Vorrede, von Beurtheilung der alchymistischen Schriften und dem Leben des Basilii begleitet von Bened. Nic. Petræo. Fünfte Edition. Hamburg, bey Gottfried Richter. 1740. 8o. pp. [clvii] + 1133 + [clvii].

Vigani, *John Francis.* Medulla chymiæ, variis experimentis aucta, multisq; Figuris illustrata. Londini, Impensis Henrici Faithorne, & Joannis Kersey ad insigne Rosæ in Cæmeterio D. Pauli, 1683. 8o. [16] + 71.

Wiegleb, *Johann Christian.* Historisch-kritische Untersuchung der Alchemie, oder der eingebildeten Goldmacherkunst; von ihrem Ursprunge sowohl als Fortgange, und was nun von ihr zu halten sey. Weimar, bey Carl Ludolf Hoffmann, 1777. 8o. pp. [xxii] + 437 + [iii].

—— *See* **Boerhaave**, *Hermann.*

Wilson, *George.* A compleat course of chymistry, containing near three hundred operations; several of which have not been publish'd before. Also, the structure of several furnaces, with near three hundred characters, which are dispers'd in chymical authors; and such instruments and vessels as are necessary in a compleat elaboratory. London: printed, and sold at the Author's house in Well-Yard, near

St. Bartholomew's Hospital; and by Walter Kettilby at the Bishop's Head in St. Paul's Church Yard, 1699. 8o. pp. [xvi] + 358.

Zetzner, *Lazarus. See* **Theatrum Chemicum.**

Zimmermann, *Johann Christian.* Allgemeine Grundsätze der theoretisch-practischen Chemie, das ist: Gründlicher und vollständiger Unterricht der Chemie: in welchem nicht nur überhaupt eine gründliche Anleitung zu allen Theilen der Chemie; sondern auch die, aus allen dreyen Natur-Reichen, vorkommende Operationes und Producta chemica mit vernünfftigen physicalischen Demonstrationibus und richtigen Experimentis auf die leichteste und sicherste Art abgehandelt und gelehret werden; nebst beygefügten Medicinischen, Chirurgischen, Oeconomischen, Metallurgischen &c. Gebrauch und Anwendung Herausgegeben von Johann Christian Zimmerman, Dresden, 1755. 4o. pp. [vi] + 22 + 1020 [wanting, pp. 1021 to end].

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Issued 26/10/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 314.

The following are abstracts of papers received during the vacation, and published or passed for publication in the *Transactions*.

151. "Some new derivatives of di*cyclo*pentadiene." By Alexander Rule.

The author has prepared a *nitrosobromide* of di*cyclo*pentadiene similar to the nitrosochloride described by Kraemer and Spilker, and also the corresponding derivatives of mono*cyclo*pentadiene. Attempts were made to prepare oxime derivatives, but the yields in each case were poor.

By treating the nitrosobromide with alcoholic sodium ethoxide, an *ethoxy*iso*nitroso*-derivative was obtained, whilst the *oxynitroso* derivative itself was prepared by treating the pyridinium compound of the nitrosochloride with moist silver oxide.

In neither case was it possible to obtain a ketone by further reactions, owing to the instability of the substances.

The piperidine base prepared from the nitrosochloride is a well-characterised derivative and forms a sparingly soluble *hydrochloride*. On reduction with sodium in alcoholic solution it is partially converted into a *diamine* base, which forms an easily soluble *hydrochloride* and a crystalline *platinichloride*.

152. "Some derivatives of 2- and 3-phenanthrol." By Herbert Henstock.

2-Phenanthryl ethyl ether was nitrated by adding nitric acid to its solution in glacial acetic acid, and the *nitro*-derivative yielded an *amino*-compound with tin and hydrochloric acid. When this was treated with nitrous acid, the *diazo*-compound, $OEt\cdot C_{14}H_8\cdot N_2\cdot SO_4Na,6H_2O$, was obtained.

The nitro-compound of the 3-ethyl ether similarly yielded an *amino*-derivative which can be diazotised.

The 3-nitro-compound, on heating with dry bromine under pressure, gave a 2 : 7-*dibromo*-derivative. By oxidation of the 3-ethyl ether with chromium trioxide a phenanthraquinone was obtained which, on treatment with hydroxylamine hydrochloride, yielded a *monoxime*.

153. "Steric hindrance in the naphthalene series."

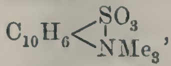
By Clarence Smith.

Sodium β-naphthylamine-8-sulphonate forms diazoamines with benzene- and *p*-toluene-diazonium chlorides, both being yellow, crystalline substances; the former melts and decomposes at 224°, the latter at 219°.

Potassium dimethyl-β-naphthylamine-8-sulphonate,

$$SO_3K\cdot C_{10}H_6\cdot NMe_2,$$

obtained from dimethyl sulphate and β-naphthylamine-8-sulphonic acid in alkaline solution, forms colourless crystals easily soluble in water or alcohol. An intermediate product in the preparation, probably *anhydrotrimethylaminonaphthalenesulphonic acid*,



$$C_{10}H_6 < \begin{matrix} SO_3 \\ | \\ NMe_3 \end{matrix},$$

is an exceedingly deliquescent, colourless, crystalline substance, soluble in water, insoluble in organic solvents, but has not yet been obtained in the pure state.

The *acid*, $SO_3H\cdot C_{10}H_6\cdot NMe_2$, forms colourless needles, is sparingly soluble in cold water, dissolves readily in hot water or alcohol, forming solutions with a fine blue fluorescence, and does not react with diazonium salts.

p-*Tolylazo*-8-*nitro*-β-*naphthylamine*, $C_7H_7N_2\cdot C_{10}H_5(NO_2)NH_2$, forms reddish-brown crystals with a green reflex and melts at 253°.

The influence of steric hindrance is very obvious when the rates are compared at which "G" and "R" salts respectively combine with *p*-toluenediazonium chloride. With approximately one-twentieth molecular solutions, the reaction was complete within five minutes in the latter case, whereas in the former, after fourteen hours, 39 per cent. of the diazonium salt, estimated as *p*-tolylazo-β-naphthol, was still uncombined. With a one-fiftieth molecular solution of "G" or "R" salt, after twenty-four hours the amounts of free diazonium salt were 31·0 and 0 per cent. respectively.

Sodium 1-*bromo*-β-*naphthol*-8-*sulphonate*, $SO_3Na\cdot C_{10}H_5Br(OH),3H_2O$, obtained from bromine and sodium β-naphthol-8-sulphonate in aqueous solutions, forms colourless, glistening leaflets; the halogen is not displaced by diazo-complexes.

154. “Electrolytic reduction. I. Aromatic aldehydes.”

By Herbert Drake Law.

By the electrolytic reduction of aromatic aldehydes, compounds of the hydrobenzoin type were obtained, the reaction proceeding according to the equation $2X{\cdot}CHO + 2H = X{\cdot}CH(OH){\cdot}CH(OH){\cdot}X$. Such substituted groups as $-OH$, $-OCH_3$, $=O_2{:}CH_2$, exercise no influence whatever on this reaction; thus vanillin, salicylaldehyde, and piperonal yielded compounds of the above type. Ketones, however, do not show this regularity, the substance formed being contaminated with further reduction products.

155. “Electrolytic reduction. II. Use of electrodes.”

By Herbert Drake Law.

The velocity of a chemical reaction at the electrodes in an electrolytic experiment is regulated by the rate of diffusion of the solute and may be represented by the following differential equation:

$$\frac{dc}{dt} = K(C - C'),$$

C and C' being the concentrations before and after the experiment. Where C' is small, then by substitution of the hydrogen equivalent for C the following equation results:

$$\frac{1}{Hc} \log \frac{H}{H - h} = K.$$

H represents the hydrogen absorbed at any time, Hc the total hydrogen required, and h the amount already used. When C' is small, the velocity is almost independent of the potential of the hydrogen, but otherwise this factor must be taken into account. Further, we have:

$$C - C' \propto 2C' \times P_{\text{H}},$$

where P_{H} is the potential factor (*Analyst*, 1906, 31, 3). This, introduced into the above equations, represents the complete action in the absence of catalytic agents.

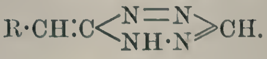
156. "Studies on optically active carbimides. Part IV. The resolution of *ac*-tetrahydro-2-naphthol by means of *l*-menthylcarbimide." By Robert Howson Pickard and William Oswald Littlebury.

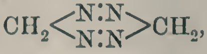
ac-Tetrahydro-2-naphthol has been resolved in a similar manner to α-phenyl-α′-4-hydroxyphenylethane (this vol., 71).

d-*ac-Tetrahydro-2-naphthol* l-*menthylcarbamate*, separated from the corresponding (*ll*) *carbamate* by fractional crystallisation from alcohol, melts at 131° and has $[\alpha]_D - 33{\cdot}4°$ in chloroform.

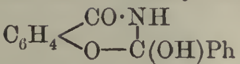
d-*ac-Tetrahydro-2-naphthol* is a pale yellow oil, which has $[\alpha]_D + 28{\cdot}2°$ in chloroform and $[\alpha]_D + 27{\cdot}6°$ in benzene. The *phenylcarbamate* melts at 115—117° and has $[\alpha]_D + 25{\cdot}2°$ in chloroform.

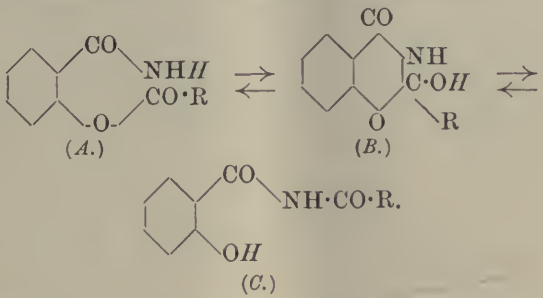
157. "Tetrazoline. Part IV." By Siegfried Ruhemann.

The author showed that the compounds $C_5H_{11}N_4I$ and $C_5H_{11}N_4I_3$, which *C*-dimethyltetrazoline, $CH_3\cdot C{<}\substack{N\cdot NH\\ NH\cdot N}{>}C\cdot CH_3$, forms with methyl iodide, have properties unlike the corresponding substances $C_3H_7N_4I$ and $C_3H_7N_4I_3$, which are obtained from tetrazoline (Ruhemann and Merriman, Trans., 1905, 87, 1768). A difference between tetrazoline and *C*-dimethyltetrazoline has also been observed with regard to the condensation products which these bases yield with aldehydes. The substance which is formed from salicylaldehyde and *C*-dimethyltetrazoline has the composition $C_{11}H_{12}ON_4,H_2O$; it therefore contains 1 molecule of water, which it loses at 100°, and its solution in dilute hydrochloric acid does not give a precipitate with platinic chloride. These properties differ from those of salicylidene tetrazoline and its analogues (*loc. cit.*). On account of these facts the author adheres to the view that the condensation products of aldehydes with tetrazoline are to be represented thus:  $R\cdot CH{:}C{<}\substack{N=N\\ NH\cdot N}{>}CH$.

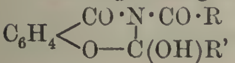
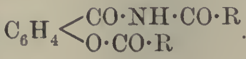
Bisdiazomethane,  $CH_2{<}\substack{N{:}N\\ N{:}N}{>}CH_2$, condenses with only 1 molecule of an aldehyde to form compounds of the formula $R\cdot CH{:}C{<}\substack{N{:}N\\ N{:}N}{>}CH_2$, which are readily hydrolysed. Their solutions in dilute hydrochloric acid do not yield precipitates with platinic chloride.

158. "Labile isomerism among acyl derivatives of salicylamide." By James McConnan and Arthur Walsh Titherley.

The authors have made a further study of the constitution of Gerhardt's benzoylsalicylamide, which is a tautomeric substance behaving both as *N*-benzoylsalicylamide and the cyclic metoxazone derivative,  $C_6H_4{<}\begin{matrix}CO\cdot NH\\ O-C(OH)Ph\end{matrix}$. In general, acyl derivatives of salicylamide show remarkable labile characters, and the changes which they undergo may be expressed by the scheme:



The possibility of individual existence of *N*-acylsalicylamides apparently depends on the nature of R, and, in general, varying degrees of stability of the types *A*, *B*, and *C* appear according to the nature of this group and according to whether the residual hydrogen atom of the NH group is further replaced.

In the case of O-*acetylsalicylamide* (m. p. 138°), which readily rearranges, the intermediate metoxazone derivative is too unstable to exist and N-*acetylsalicylamide* (m. p. 147°) results. *O*-Benzoyl-*N*-acetylsalicylamide (m. p. 96°) passes with extreme ease into N-*acetyl*-2 : 2-*phenylhydroxybenzometoxazone* (m. p. 106°), which readily reverts to the open-chain isomeride (m. p. 96°). O-*Acetyl*-N-*benzoylsalicylamide* (m. p. 124°) rearranges less easily than its isomeride melting at 96°, yielding, however, the same metoxazone derivative. *NN*-Diacyl salicylamides, $C_6H_4{<}\begin{matrix}CO\cdot N(CO\cdot R)_2\\ OH\end{matrix}$, are apparently too unstable to exist, the tendency to rearrange being so great that the isomeric metoxazone derivative,  $C_6H_4{<}\begin{matrix}CO\cdot N\cdot CO\cdot R\\ O-C(OH)R'\end{matrix}$, is formed, which in its turn may rearrange, yielding the open-chain derivative  $C_6H_4{<}\begin{matrix}CO\cdot NH\cdot CO\cdot R\\ O\cdot CO\cdot R\end{matrix}$.

159. "The action of nitrous acid on the arylsulphonylmetadiamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait [with E. G. Couzens].

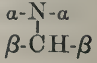
The arylsulphonyl derivatives of the ortho- and para-diamines having been shown to yield characteristic diazoimides on treatment with nitrous acid, a series of the arylsulphonylmetadiamines,

$$R\cdot SO_2\cdot NH\cdot X\cdot NH_2,$$

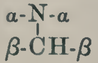
was examined in order to ascertain whether their diazonium chlorides, $R{\cdot}SO_2{\cdot}NH{\cdot}X{\cdot}N_2Cl$, would give rise to diazoimides. The monobenzenesulphonyl derivatives of tolylene-2 : 4-diamine, 4 : 6-diamino-*m*-xylene, and diaminomesitylene were prepared and subjected to the action of nitrous acid in hydrochloric acid solution; their diazonium chlorides, which were stable in acid solution or in the dry state, underwent decomposition at the ordinary temperature on treatment with sodium acetate, evolving at least 50 per cent., and in some cases even the whole of the diazo-nitrogen, and leaving either arylsulphonylaminophenols or ill-defined azo-derivatives or mixtures of these substances. In no case could any diazoimide be detected.

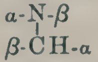
160. "Dinaphthacridines."

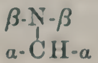
By Alfred Senier and Percy Corlett Austin.

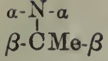
The authors have made a further study of the interaction of methylene di-iodide on naphthylamines, which was introduced by one of them and Goodwin in 1902 as a general method of acridine synthesis. They have also found the requisite conditions for the substitution of methylene dichloride for the di-iodide and of its analogues, ethylidene chloride and benzal chloride, in the synthesis of dinaphthacridines, which renders the preparation of the  $\begin{array}{c}\alpha\text{-N-}\alpha\\ |\\ \beta\text{-CH-}\beta\end{array}$ dinaphthacridine much easier.

The notation employed is that proposed by Senier (*Brit. Assoc. Report*, 1903, 616; *Chem. News*, 1903, **88**, 272).

When methylene dichloride and α-naphthylamine were heated in a closed tube at 230°,  $\begin{array}{c}\alpha\text{-N-}\alpha\\ |\\ \beta\text{-CH-}\beta\end{array}$ dinaphthacridine was formed. It distils unchanged, melts at 185·5° (189° corr.), not at 173° as previously stated, exhibits triboluminescence, and yields an *aurichloride*.

 $\begin{array}{c}\alpha\text{-N-}\beta\\ |\\ \beta\text{-CH-}\alpha\end{array}$ Dinaphthacridine, prepared by the methylene dichloride and other new methods, distils unchanged, is not triboluminescent, melts at 223° (228° corr.), and forms a *platinichloride* and *bisdinaphthacridine hexabromide.*

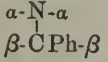
 $\begin{array}{c}\beta\text{-N-}\beta\\ |\\ \alpha\text{-CH-}\alpha\end{array}$ Dinaphthacridine (β-naphthacridine, Reed) was prepared by the action of methylene dichloride on β-naphthylamine in a closed tube. It is not triboluminescent. Using methylene di-iodide, it was found that, by varying the conditions of the experiment, (1) Reed's base alone, (2) Morgan's base chiefly, or (3) a mixture of the two, could be obtained.



$\begin{array}{c}\alpha\text{-N-}\alpha\\ |\\ \beta\text{-CMe-}\beta\end{array}$

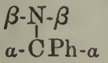
Methyldinaphthacridine, obtained from ethylidene chloride and α-naphthylamine, forms greenish-yellow octahedra melting at 219° (224° corr.), which are not triboluminescent.

The *hydrochloride, aurichloride, platinichloride,* and *dibromide* were described.



$\begin{array}{c}\alpha\text{-N-}\alpha\\ |\\ \beta\text{-CPh-}\beta\end{array}$

Phenyldinaphthacridine, prepared from benzal chloride and α-naphthylamine in presence of naphthalene, forms yellow, hexagonal plates, which are not triboluminescent and melt at 224° (229° corr.). It yields a *hydrochloride, platinichloride,* and *aurichloride.*



$\begin{array}{c}\beta\text{-N-}\beta\\ |\\ \alpha\text{-CPh-}\alpha\end{array}$

Phenyldinaphthacridine was prepared from benzal chloride and β-naphthylamine. It is not triboluminescent and melts at 293°, (301·5° corr.).

161. "The relation of position isomerism to optical activity. VII. The rotation of the menthyl esters of three isomeric dinitrobenzoic acids." By Julius Berend Cohen and Henry Percy Armes.

The menthyl esters selected for investigation were those of the 2 : 4- 2 : 6-, and 3 : 5-dinitrobenzoic acids. In a previous communication on this subject (*Trans.*, 1905, 87, 122) it was shown that of the three mononitro-esters the ortho-compound produced the greatest rotation and the para- the least, the meta-ester lying between the two. The present results agree with the former observations. The di-ortho-compound has the highest molecular rotation, $[M]_D - 642°$, and the di-meta- the lowest, $[M]_D - 246°$, whilst the compound which contains one nitro-group in the ortho- and one in the para-position has a constant which is nearly the mean of the other two, namely, $[M]_D - 470°$. At the conclusion of the paper, one of the authors draws attention to the evidences of steric hindrance which are afforded by the action of di-ortho-substituted acid chlorides on menthol.

162. "The properties of 2 : 3 : 4 : 5-tetrachlorotoluene. A correction." By Julius Berend Cohen and Henry Drysdale Dakin.

In a paper on the chlorination of the trichlorotoluenes (*Trans.*, 1904, 85, 1274) it was stated that whereas 3 : 4 : 5-trichlorotoluene was converted on chlorination into a tetrachlorotoluene (m. p. 97—98°) which gave a nitro-derivative melting at 159°, 2 : 3 : 4 : 5-tetrachlorotoluene from 2 : 4 : 5-trichloronitrotoluene melted at 86—88° and gave a nitro-derivative having the same melting point. It is now found that the latter observation is incorrect, and that the tetrachlorotoluene obtained from 2 : 4 : 5-trichloronitrotoluene is identical with that prepared by the chlorination of 3 : 4 : 5-trichlorotoluene.

163. "A method for the formation of succinic acid and of its alkyl derivatives." By Annie Higson and Jocelyn Field Thorpe.

The cyanohydrins of aldehydes and ketones readily react in the cold with the sodium derivative of ethyl cyanoacetate, forming the sodium derivatives of dicyano-ethyl salts in accordance with the general equation:

$$CO_2Et\cdot C(CN)NaH + HO\cdot C(CN)RR' = CO_2Et\cdot C(CN)Na\cdot C(CN)RR' + H_2O.$$

The free ethyl salts can be prepared from these sodium derivatives on treatment with acids, and on hydrolysis may be converted into the corresponding derivatives of succinic acid.

The following cyanohydrins have been investigated:

Formaldehydecyanohydrin	giving	succinic acid.
Lactic nitrile	,,	methylsuccinic acid.
Acetonecyanohydrin	,,	*asym*-dimethylsuccinic acid.
Methylethylketonecyanohydrin	,,	methylethylsuccinic acid.
Œnantholcyanohydrin	,,	hexylsuccinic acid.
Mandelic nitrile	,,	phenylsuccinic acid.

It is further pointed out that the sodium compound which is formed in the condensation may be treated directly with an alkyl iodide, and in this way further alkylated derivatives of succinic acid can be prepared. For example, *cis*- and *trans*-dimethylsuccinic acids were obtained from lactic nitrile and trimethylsuccinic acid from acetonecyanohydrin, in each case by treating the sodium compound formed in the condensation of these cyanohydrins and ethyl sodiocyanoacetate with methyl iodide and hydrolysing the product.

164. "The gum of *Cochlospermum Gossypium*." By Henry Haliburton Robinson.

A small tree, *Cochlospermum Gossypium*, yields a gum which resembles tragacanth in absorbing a large quantity of water and swelling up to many times its original size; it is also remarkable for its property of slowly giving off acetic acid.

By hydrolysing the gum with dilute sulphuric acid, a dibasic acid of the formula $C_{23}H_{26}O_{21}$ was obtained, for which the name *gondic acid* is proposed. Gondic acid is soluble in water, and is precipitated from its aqueous solution by alcohol as a white, amorphous substance; by evaporation it is obtained in colourless, transparent flakes. Like gum arabic, it gives a solution having adhesive power. When dried at 100°, 100 parts of the acid neutralise 23·7 parts of barium oxide, and the rotatory power is $[\alpha]_D + 97 \cdot 7^\circ$; it forms salts by addition and not by replacement, thus the barium salt is $C_{28}H_{36}O_{21},BaO$.

From the liquids from which the gondic acid had been separated, two sugars were obtained; one of these was xylose and the other was a hexose, possibly galactose, although it presented some differences.

The original gum yielded 14 per cent. of acetic acid. By prolonged treatment with cold sodium hydroxide solution and then acidifying and dialysing, a clear, viscid, colloid solution was obtained containing a de-acetylated product, which can be precipitated by alcohol in presence of hydrochloric acid. This substance, for which the name *a-cochlosperminic acid* is proposed, gelatinises with water, but does not dissolve.

165. "Studies in the acridine series. Part IV. The methylation of chrysophenol." By Albert Ernest Dunstan and John Theodore Hewitt.

In previous communications, anhydro-bases have been described resulting from the acetylation of 2-amino-3 : 7-dimethylacridine, benzoflavine, and chrysaniline, conversion into quaternary ammonium compounds, and subsequent removal of the acetyl groups (Trans., 1904, **85**, 529; 1905, **87**, 1058, and 1906, **89**, 482). Fischer and Körner (*Ber.*, 1884, **17**, 203; *Annalen*, 1886, **226**, 175) examined the chrysophenol which Claus had produced by heating chrysaniline with hydrochloric acid under pressure. The present authors conclude that it is the amino-group in the acridine nucleus which is displaced by hydroxyl, and regard chrysophenol as 2-hydroxy-5-*p*-aminophenylacridine.

This base gave a *diacetyl* derivative which, when treated with dimethyl sulphate, yielded a quaternary ammonium salt. On removal of the acetyl groups, salts of a base were obtained which, when first liberated, is soluble in excess of alkali as well as of acid. This is probably 2-*hydroxy*-5-p-*aminophenyl*-10-*methylacridanol*-5; on drying at 100° it gave an *anhydro*-base, $C_{20}H_{16}ON_2$. Various derivatives of chrysophenol, the *acetyl* compound, and the *base* $C_{20}H_{16}ON_2$ were described, and the solutions of the different substances have been examined with regard to fluorescence.

166. "Optically active reduced naphthoic acids. Part III. The relative catalytic effect of bases on the compounds of Δ^2-dihydro-1-naphthoic acid." By Robert Howson Pickard and Joseph Yates.

Sodium *d*-Δ^2-dihydro-1-naphthoate is transformed in aqueous solution in the presence of hydroxyl ions to the salt of the corresponding Δ^1-acid. The "strengths" of various inorganic and organic bases as regards this specific reagent have been compared and found to correspond roughly with those deduced from the electrical conductivities. The influence of sodium chloride on the velocity of the transformation is very similar to its influence on the velocity of the catalytic hydrolysis of methyl acetate. There is no difference in the rate of transformation of the sodium salts of the dextro- and lævo-acids.

The methyl ester of the *d*-Δ^2-acid is transformed in the presence of an organic base in an anhydrous organic solvent with a much greater velocity than the transformation of the sodium salt in water.

The mechanism of the two transformations is probably different, the ester being transformed in the presence of a tertiary base.

167. "Estimation of copper by titanium trichloride." By Ezra Lobb Rhead.

Copper may be quickly and accurately estimated by means of a standard solution of titanium trichloride in presence of potassium thiocyanate.

Cupric salts are reduced and the copper precipitated as cuprous thiocyanate in presence of either sulphuric or hydrochloric acid. The end of the reaction may be rendered more distinct by adding a ferrous salt, either mixed with the standard solution or separately. Cupric salts oxidise ferrous salts, and a red colour is produced with the thiocyanate present; its discharge marks the end of the reaction, which is perfectly sharp.

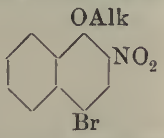
The titration is conducted below 30°, and the whole of the reagent added as quickly as possible.

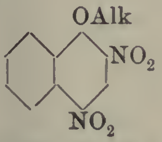
Ferric and cupric salts may be estimated together, and the amount of iron deducted after being separately determined.

The new method is as accurate as the electrolytic and iodometric methods, and free from the objections and difficulties attaching to them.

168. "Notes on derivatives of α-*N*-alkylated naphthylamine." By Raphael Meldola.

Naphthalene derivatives of the types





are characterised by the extreme mobility of the alkyloxy-group, which is readily exchanged for the alkylamino-group when the compounds in question are treated in alcoholic solution with amines of the type $R \cdot CH_2 \cdot NH_2$. By this means, 2 : 4-*dinitro-α-ethylnaphthylamine* (m. p. 169—170°) and 4-*bromo-2-nitro-α-benzylnaphthylamine* (m. p. 126—127°) and some of their derivatives have been prepared.

The following note has been received during the vacation:

169. "Note on a compound of thiocarbamide and potassium iodide." By Emil Alphonse Werner.

While studying the interaction of iodine and thiocarbamide in aqueous solution, the author incidentally obtained *tetra-thiocarbamide potassium iodide*, $(CSN_2H_4)_4KI$, analogous to the tetra-thiocarbamide ammonium bromide, $(CSN_2H_4)_4 \cdot NH_4Br$, prepared and described by Emerson Reynolds (*Trans.*, 1891, **59**, 385). It is formed quantitatively when hot solutions of the separate substances in absolute alcohol are mixed; the new compound crystallises as the liquid cools, in long, delicate, interlacing needles melting at 189—190° and possessing a beautiful satiny lustre, resembling the ammonium bromide compound.

0·3 distilled with an excess of ferric sulphate solution gave 0·08108 iodine. I = 27·03.

$C_4H_{16}N_8IS_4K$ requires I = 27·02 per cent.

The substance is dissociated in dilute aqueous solution, but may be crystallised from a very concentrated solution without sensible decomposition.

All attempts to prepare an analogous, or indeed any compound, from thiocarbamide and sodium iodide were unsuccessful, such a sharp difference in the behaviour of the potassium and sodium salts being rather remarkable.

The compound with ammonium iodide (m. p. 186°) has already been prepared. Potassium bromide and thiocarbamide combine only with difficulty.

Thursday, October 18th, 1906, at 8.30 p.m., Professor Sir William Ramsay, K.C.B., F.R.S., Foreign Secretary, in the Chair.

PRESENTATION OF THE LONGSTAFF MEDAL.

In the absence of the President through illness, the following address from him was communicated :

The Longstaff Medal, as announced last Session, has been awarded to Prof. Walter Noel Hartley for his researches in Spectro-chemistry. It is over a quarter of a century since Hartley first entered this domain of physical chemistry which he has since cultivated with unremitting zeal and conspicuous success. To him belongs the distinct credit of being among the first to realise that valuable information concerning the constitution of chemical compounds might be obtained by the study of their absorption spectra, not only within the region of the visible spectrum, but, what is of far greater importance, in that ultra-violet region which is so easily dealt with by the photographic plate. His first contribution (in conjunction with Prof. Huntingdon) appeared in 1879, and must be regarded as the pioneer research which laid the foundation of all subsequent work in the systematic study of absorption spectra carried out by Hartley himself in conjunction with various collaborators or by independent workers inspired by the success of the method. The merits of this first memoir and of all the results which have followed from it consist not only in the establishment of the principle of a relationship between a particular optical property of a molecule and its chemical structure, but in the practical development of the methods by which this principle has been established. Setting out originally with the object of studying the ultra-violet absorption spectra of compounds of known constitution by means of the photographic plate, Hartley was soon compelled to turn his attention to emission spectra, and his well-known tin-lead-cadmium alloy was devised and used as a means of supplying spark spectra rich in ultra-violet lines of known wave-lengths. His later incursions into this field of spectroscopy are sufficiently well known. It is only necessary to refer to his spectrographic method of studying alloys and his researches on flame spectra and their applications to mineral analysis and to metallurgical processes. While there is no branch of spectro-chemistry which he has handled to which Hartley has not made valuable contributions, it is for the long series of researches on the relationship between absorption spectra and chemical constitution commencing in 1879 and continuing down to his latest communication published in last year's volume of our *Transactions* that the Longstaff Medal is more especially awarded. Although associated with many colleagues in the course of this work, the main source of inspiration has doubtless been Hartley himself. By his labours he has placed in the hands of chemists a method of studying chemical constitution which must for all time be taken into consideration. It is not only the method itself, but the mode of expressing the results by what he called "curves of molecular vibration" that first enabled chemists to realise the power of the new weapon. The continuous series of investigations proceeding from Hartley and his colleagues since 1879, and the more recent and no less important contributions now being made by other workers in the same field, all bear witness to the fertility of this spectroscopic method. An appeal to the more modern literature of the subject will show that not only has the original conception of the pioneer been amply justified, but that his methods have shown themselves capable of dealing with the more recondite problems of isomerism and tautomerism in its various aspects and the relationship between colour and chemical constitution. It is perhaps safe to say that no discussion on this latter subject can lead to definite conclusions if absorption spectra be ignored.

In presenting the Longstaff Medal to Prof. Hartley it will doubtless be the unanimous desire of the Fellows of the Chemical Society that the presentation should be accompanied by the wish that he may long be spared to carry on that branch of physico-chemical work of which he is practically the founder, and with the development of which his name will always be honourably associated to the lasting credit of British Science.

The Longstaff Medal was then presented to Professor Walter Noel Hartley by the Chairman, and duly acknowledged.

Messrs. G. H. A. Clowes, B. Flurscheim, S. S. Pickles, H. Rogerson, and H. W. M. Willett were formally admitted Fellows of the Society.

The Chairman stated that on the occasion of the Jubilee of the Foundation of the Coal-Tar Colour Industry celebrated in July, the following address was presented to Sir William H. Perkin by the President:

To William Henry Perkin, LL.D., Ph.D., F.R.S.,
From the Chemical Society.

Among those who congratulate you on the occasion of the celebration of the fiftieth anniversary of your discovery of the first Coal-Tar Colour, the Chemical Society is not only aware of your great services to Chemical Science and Chemical Technology but may claim to know you more intimately than can any other body. Elected a Fellow in the year in which you began to manufacture Mauve, you are one of its oldest members; as one of its Secretaries during the years 1869–83, and as its President in 1883–85, you have rendered most valuable service in the conduct of its affairs; but it is chiefly for your many contributions to its *Proceedings* that it is indebted to you. Singularly consistent in your choice of the Society's publications as the means of making your work known, you have at all times been one of the chief supporters of its efforts to promote the progress of Chemical Science.

It is impossible to overrate the value directly and indirectly of your discovery; the evidence of the influence which it has exercised is overwhelming. And it is noteworthy that you should have been active not only at the beginning of the colour industry but that you have more than once intervened to assist its progress; notably by the part which you took in the development of the manufacture of the Madder colours; by your work on Cinnamic acid, which was of critical importance in the early stages of the development of the artificial indigo industry; and by your discovery of a method of producing Coumarin artificially, which entitles you to rank as the pioneer in the establishment of an important offshoot of the colour industry, that of artificial perfumes.

The extraordinary progress of Chemical Science during the past half century indeed is in a very large measure the outcome of your discovery; had it not been proved to be a useful science, Chemistry would never have attracted the army of workers whose victories have led to the marvellous developments which are to be chronicled on every side. The advance of knowledge is little short of miraculous, especially in view of the difficulties with which chemists are confronted.

But however highly your technical achievements be rated, those who have been intimately associated with you must feel that the example which you have set by your rectitude as well as by your modesty and sincerity of purpose is of chiefest value. That you should have been able, as a very young man, to overcome the extraordinary difficulties incident to the establishment of an entirely novel industry fifty years ago, is a clear proof that you were possessed in an unusual degree of courage, independence of character, judgment, and resourcefulness; but even more striking is your return into the fold of scientific workers and the ardour with which you have devoted yourself to the prosecution of abstract physico-chemical inquiries of exceptional difficulty. In the account of your renowned Master, Hofmann, you have stated that one of your great fears on entering into technical work was that it might prevent your continuing research work; that you should have felt such regret at such a period is sufficiently remarkable and it must be a source of enduring satisfaction to you to know that your later scientific work deserves, in the opinion of many, to rank certainly no less highly than your earlier.

It is with a feeling of just pride that the Chemical Society now places on record its deep sense of the obligation which you have laid upon it by having won for British Chemical Science the incomparable distinction of making so great a step in the progress of civilisation as is marked by your discovery and its consequences.

Signed on behalf of the Chemical Society this Twenty-sixth day of July, 1906,

RAPHAEL MELDOLA, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, } *Honorary*
ARTHUR W. CROSSLEY, } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

It was also announced that during the celebration by the University of Aberdeen of its Fourth Centenary, the following address was presented in the name of the Society by the President:

TO THE UNIVERSITY OF ABERDEEN.

On behalf of the Chemical Society we beg to offer our most hearty congratulations to the University of Aberdeen on the occasion of the celebration of its Fourth Centenary. At an early period in its history the University gave prominence to Chemistry and by so doing has rendered the greatest service to our Science as an educational subject. The University Chair of Chemistry has been filled successively by a number of distinguished men, Fellows of our Society, many of whom have extended the boundaries of Scientific Knowledge by their original investigations.

The inauguration of the new buildings will be regarded as marking the commencement of a new period of useful activity in the educational history of this country. The establishment of the new Laboratories will give the greatest satisfaction to English Chemists as it is recognised that the improved facilities for instruction and research thus placed at the disposal of the University will insure the future development of their Science in Aberdeen, both as a branch of Academic Learning and as a subject of the greatest importance to the material welfare of the Nation.

In the name of the Council and Fellows of the Chemical Society we desire to place on record our most sincere wishes for the continued prosperity of the University of Aberdeen, both in our own Department of Scientific Knowledge and in all those studies which during the four past centuries it has fostered with such conspicuous success.

Signed on behalf of the Chemical Society this Twenty-sixth day of July, 1906,

RAPHAEL MELDOLA, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, } *Honorary*
ARTHUR W. CROSSLEY, } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

Certificates were read for the first time in favour of Messrs. :

Paul Seidelin Arup, M.A., Marsden Villa, 62, Haverstock Hill, N.W.
Oscar Walter Bethea, Meridian, Miss., U.S.A.
James Spears Broome, B.Sc., 18, Seedley Park Road, Pendleton, Manchester.
Thomas Henry Byrom, 31, Wrightington Street, Wigan.
John Carmichael, 10, Cortayne Road, Fulham, S.W.
Percy Henry Carpenter, A.I.C., 46, Streathbourne Road, Upper Tooting, S.W.
Charles Taylor Cockburn, 34, Queen's Gate, Dowanhill, Glasgow.
Hubert Frank Coward, M.Sc., Hulme Hall, Plymouth Grove, Manchester.
Archibald Prideaux Davson, A.R.C.S., 39, Blandford Square, N.W.
Anthony Nisbet Fitzgerald, B.A., B.Sc., 12, St. Mary's Road, Strood, Rochester.
Octavius Hall, L.R.C.S., L.R.C.P., 6, Devonshire Villas, Plymouth.
H. Norman Hanson, Field Head, Brighouse, Yorks.
Charles Percy Hines, B.Sc., The Grammar School, Dartford.
Edward Rees Jones, Llangedwyn Vicarage, Oswestry.
William Richard Simpson Ladell, 19, Alwyne Road, N.
David McIntosh, B.Sc., Stamford School, Stamford.
John Mastin, Woodleigh House, Totley Brook, Nr. Sheffield.
George Naylor, 45, Hornby Road, Blackpool.
Charles Harold Oxland, B.Sc., 37, Waterloo Road, Bedford.
Frederic Ion Richardson, B.A., Glenarbor, Kew, Nr. Melbourne, Australia.
Reginald Ernest Robinson, B.A., The Villas, Stoke-on-Trent.
John Lionel Simonsen, M.Sc., 152, Barlow Moor Road, West Didsbury, Manchester.
Charles Smith, Knowsley Road, Smithells, Bolton.
Harry George Telling, Cooksbridge, Sussex.
George Gordon Watt, 26, Albert Square, Clapham Road, S.W.
Chr. Winther, The University, Copenhagen.

Of the following papers, those marked * were read :

*170. "The description and spectrographic analysis of a meteoric stone." By Walter Noel Hartley.

This stony meteorite was seen to fall in the Kangra Valley, Northern Punjaub, in 1897, and was received in the same year from Lt.-Colonel Donald St. John Dundas Grant, of the India Medical Service. It consists of a crystalline stony base, throughout which are dispersed bright silvery metallic particles from 0·5 to 1 mm. in diameter. The analysis was carried out according to the method previously described (Hartley and Ramage, *Trans.*, 1901, **79**, 61). The principal constituents of the metallic portion are iron, nickel, cobalt, and chromium, with small quantities of copper, silver, lead, and gallium. Manganese, calcium, potassium, and sodium are present only in minute proportions. The chief components of the silicates other than silica are calcium and magnesium oxides. The bases present in minute proportions are iron, nickel, chromium, strontium, lead, silver, manganese, potassium, and sodium.

*171. "Malacone, a silicate of zirconium containing argon and helium." By Stanhope Kitchin and William George Winterson.

This mineral, found at Hitteroe and Arendal, Norway, is radioactive and gives off a mixture of helium and *argon* when heated. As it is the only mineral from which argon has been obtained, a careful analysis was made with the object of seeing whether the presence of any unknown or unusual constituent would account for the presence of the argon. The analysis, discounting ferric oxide, uranium oxide, &c., points to the ratio $3ZrO_2 : 2SiO_2$ between the zirconia and the silica. The zirconia, converted into the basic chloride $ZrOCl_2$ and fractionally crystallised, was found to give the ratio 1 : 2 between the zirconium and chlorine, taking the atomic weight of zirconium at its accepted value, 90.

The mineral is feebly radioactive, and its radioactivity is considerably higher than that deduced from its content of uranium ; but it still remains to make a careful examination of the nature of the emanation evolved, which, although it has a considerable period of decay, has not been proved to be identical with that from radium.

*172. "The relationship of colour and fluorescence to constitution Part I. The condensation products of mellitic and pyromellitic acid with resorcinol." By O. Silberrad.

Mellitic and pyromellitic acids condense with resorcinol to form compounds analogous to fluorescein.

Mellitic acid forms three series of products, namely, mono-, di-, and tri-xanthydryl derivatives, of which the dixanthydryl derivatives exist in two modifications, namely, meta and para. Pyromellitic acid forms mono- and di-xanthydryl derivatives. Representatives of all of these classes have been prepared.

One of the chief interests of the work lies in its bearing on the quinone theory of the structure of the phthaleins. Many of the compounds described do not admit of formulation on the quinone type, but are nevertheless intense colouring matters and strongly fluorescent. The analogy between these compounds and the phthaleins is so close that it appears very probable that the latter also contain no quinone group.

Indications have also been obtained that the change from a lactonic structure to that of a carboxylic acid and *vice versâ* does not take place with the ease which has generally been assumed; this also has an important bearing on the supposed tautomerism of the phthaleins.

The structure of the melliteins and pyromelliteins follows in general from the method of preparation and the results of analysis. In the case of the dixanthydryl derivatives, it was necessary to differentiate between the meta- and para-isomerides, by determining whether they were capable of further combining with resorcinol.

The following compounds, together with their *potassium*, *lithium*, *ammonium*, *copper*, *lead*, *mercury*, *barium*, *cobalt*, *iron*, and *silver* salts, were investigated:

3 : 6 : 9-*Trihydroxyxanthydrylbenzene*-2-*carboxylactone*-4 : 5-*dicarboxylic acid*, together with its *tetrabromo*- and *tetraiodo*-derivatives.

3 : 3′ : 6 : 6′ : 9 : 9′-*Hexahydroxy*-m-*dixanthydrylbenzene*-2 : 4 : 5 : 6-*tetracarboxylic acid* and its *octobromo*-derivative.

3 : 3′ : 6 : 6′ : 9 : 9′-*Hexahydroxy*-p-*dixanthydrylbenzene*-2 : 3 : 5 : 6-*tetracarboxylic acid*.

3 : 3′ : 3″ : 6 : 6′ : 6″ : 9 : 9′ : 9″-*Nonohydroxy*-sym-*trixanthydrylbenzene*-2 : 4 : 6-*tricarboxylic acid*, together with its *dodecabromo*- and *dodecaiodo*-derivatives.

*173. "Separation of $\alpha\alpha$- and $\beta\beta$-dimethyladipic acids."

By Arthur William Crossley and Norah Renouf.

Experiments were described by which it has been found possible, contrary to the statement of Blanc (*Bull. Soc. chim.*, 1905, [iii], **33**, 879), to separate $\alpha\alpha$- and $\beta\beta$-dimethyladipic acids. The method depends on the different solubilities of these two acids in water saturated with hydrogen chloride and in a mixture of chloroform and light petroleum.

*174. "Action of alcoholic potassium hydroxide on 3-bromo-1:1-dimethylhexahydrobenzene." By Arthur William Crossley and Norah Renouf.

Further investigation of 1:1-dimethyl-Δ^3-tetrahydrobenzene (*Trans.*, 1905, **87**, 1499), prepared by the action of alcoholic potassium hydroxide on 3-bromo-1:1-dimethylhexahydrobenzene, has shown it to be a mixture of this hydrocarbon with the isomeric 1:1-dimethyl-Δ^2-tetrahydrobenzene, in which the former always predominates.

This has been rendered possible by the discovery of a means of separating the oxidation products of these two substances, namely, $\alpha\alpha$- and $\beta\beta$-dimethyladipic acids.

*175. "The conversion of morphine and codeine into optical isomerides. (Preliminary communication.)" By Frederic Herbert Lees and Frank Tutin.

It was demonstrated by Schryver and Lees (*Trans.*, 1900, **77**, 1024, and 1901, **79**, 563) that the chloro- and bromo-derivatives of morphine and codeine of the respective types $C_{17}H_{18}O_2N\cdot X$ and $C_{18}H_{20}N\cdot X$, prepared and described by them (*loc. cit.*), do not regenerate simply the original bases when they are hydrolysed by water. In every case a mixture of bases isomeric with the parent substance was produced, and of these *iso*morphine, β-*iso*morphine, and *iso*codeine were isolated and described. As *iso*morphine appeared to be the chief product of the action of water on bromomorphide (m. p. 170°) it was fully studied in order to obtain information respecting its relation to morphine. Of the two theories advanced respecting this relation, that of stereoisomerism was at the time considered to be the less probable.

From the consideration of the fact that Schryver and Lees demonstrated a complete chemical analogy between morphine and *iso*morphine (compare also Knorr and Hawthorne, *Ber.*, 1902, **35**, 3010), and that the only differences between the bases are of a purely physical character and such as are found among optical isomerides, the present authors conclude that the isomerism must without doubt be optical in character. Experimental evidence confirming this view has now been obtained.

Since the scope of the present investigation, on which the authors have been engaged for some time, has necessarily become extended to a study of the products of the hydrolysis of all the mono-halogen derivatives of morphine and codeine, they intended to delay publication until the whole subject was completed. The appearance, however, of a recent paper by R. Pschorr (*Ber.*, 1906, **39**, 3130), entitled "Halogen

Derivate von Morphin und Codein und deren Abbau," from which it is evident that the halogen derivatives obtained by Schryver and Lees are receiving attention, renders it desirable that the authors should publish some of their results and conclusions in order to indicate the lines on which they are still working.

Bromocodeide (m. p. 162°), on hydrolysis with water, gives an optically active mixture consisting, in unequal proportions, of bases isomeric with codeine. By fractionally crystallising the mixture from ethyl acetate and from alcohol, until products were obtained which showed no change in melting point and specific rotatory power, the following substances were isolated :

A-Base.—This formed slender, prismatic needles melting at 145—145·5°, and had $[\alpha]_D$ $-205°$ in chloroform.

B-Base.—This formed colourless, tabular prisms melting at 171—172°, and had $[\alpha]_D$ $-155°$ in chloroform.

When codeine is treated with excess of phosphorus tribromide in chloroform, the reaction is most vigorous, and bromination is almost immediately complete. When this solution is heated on a water-bath for a quarter of an hour instead of for one hour, as was previously the case, the resulting bromo-derivative apparently contains less of the crystalline bromocodeide (m. p. 162°) and is a mixture. When this product is hydrolysed with water and the resulting mixture of isomeric codeines fractionally crystallised, codeine (m. p. 155°, $[\alpha]_D$ $-122°$) was isolated in addition to the above-mentioned A- and B-bases.

The substance described above as the B-base has now been shown to be *iso*codeine, the codeine analogue of *iso*morphine, for it is readily produced from the latter by methylation with sodium ethoxide and dimethyl sulphate. The *iso*codeine obtained by Schryver and Lees (*loc. cit.*) was apparently contaminated with a small proportion of the A-base.

The A-base, although undergoing no resolution by numerous crystallisations from several solvents, has been proved to be a molecular mixture of *iso*codeine (m. p. 171—172°) and a more highly lævorotatory isomeride which has not yet been prepared in the pure state.

By the reactions mentioned, the authors have thus obtained conclusive evidence of the formation in unequal proportions of codeine and two other optically isomeric lævorotatory bases.

These facts permit of the following conclusions respecting the constitution of morphine :

(1) The above-mentioned isomeric codeines are the result of the racemisation of two asymmetric carbon atoms in a molecule which must necessarily contain a third asymmetric system.

(2) The carbon atoms which undergo racemisation are most probably those in the reduced phenanthrene nucleus to which the alcoholic

hydroxyl group and the nitrogen atom are respectively attached. It follows from this that the latter carbon atom must necessarily be hydrogenised in order to be asymmetric.

(3) The possible isomeric codeines produced by the racemisation of the two asymmetric carbon atoms must be represented by the configurations + + −, + − −, − + −, − − −, as at least three of them are lævorotatory.

176. "The aminodicarboxylic acid derived from pinene." By William Augustus Tilden and Donald Francis Blyther.

This is the acid originally obtained by Tilden and Burrows (*Trans.*, 1905, **87**, 344). In the present communication details are given for the preparation of the acid and its *hydrochloride*, *nitrate*, *acid oxalate*, *copper* salt, *ethyl* ester and its *hydrochloride*, and the *acetyl* derivative of the amino-acid.

Experiments are being continued on the products of the oxidation of the acid and of its condensation with benzaldehyde and glycocine.

177. "The preparation and properties of dihydropinylamine (pinocamphylamine)." By William Augustus Tilden and Frederick George Shepheard.

Dihydropinylamine is the chief product of the reduction of nitrosopinene by means of boiling amyl alcohol and sodium. The free base is a colourless liquid having an odour like pinylamine and boiling at 198—199°.

The *hydrochloride*, *platinichloride*, *picrate*, *nitrate*, *oxalate*, also the *acetyl* and *benzoyl* derivatives and the *carbamide*, have been prepared and analysed. The alcohol obtained by the action of nitrous acid on the aqueous solution of the hydrochloride of the base boils at 103° under 15 mm. pressure, and is identical with pinocampheol prepared by reduction of pinocamphone.

178. "Determination of nitrates." By Frank Sturdy Sinnatt.

Knecht and Hibbert's method for the estimation of picric acid (*Ber.*, 1903, **36**, 1549) may be applied to the estimation of nitrates.

The process depends on the conversion of the nitrate into picric acid by means of phenolsulphonic acid, the picric acid being subsequently estimated by titanium trichloride.

Up to the present the method has only been used for the estimation of recrystallised pure potassium nitrate; it was carried out as follows:

Ten c.c. of the solution of potassium nitrate containing 0·1 per cent. of potassium salt were evaporated to dryness in a steam oven, 5 c.c. of a solution of phenolsulphonic acid added, and the heating continued for half an hour. The whole was then washed into a flask and, after adding hydrochloric acid, titrated with titanium trichloride.

Three titrations carried out in the above manner required, for 0·01 gram of potassium nitrate, 20·14, 20·47, and 20·2 c.c. of titanium trichloride (1 c.c. = 0·0004860 gram of potassium nitrate), corresponding to 0·009788, 0·009948, and 0·009817 gram of potassium nitrate respectively. The error is not so great as when the colorimetric method is used.

179. "The nature of ammoniacal copper solutions."
By Harry Medforth Dawson.

The nature and dissociation of the complex cupri-ammonia compound which is present in ammoniacal solutions of copper sulphate has been further examined. The method consisted in determining the amount of free ammonia in variously concentrated copper solutions containing different relative amounts of ammonia by extracting these solutions with chloroform. Special precautions have been taken with the view of obtaining accurate results, and a correction has been applied for the ammonia-displacing action of the dissolved salt. The experimental data indicate the existence in solution of a dissociating complex compound containing 4 molecules of ammonia per atom of copper. The ammonia dissociation increases with dilution and, for a given copper concentration, with decrease in the relative proportion of ammonia. From experiments in which the free ammonia in ammoniacal copper sulphate solutions was determined by the method of gas-bubbling, Locke and Forssall (*Amer. Chem. J.*, 1904, **31**, 268) have drawn the conclusion that such solutions contain practically the whole of the copper in the form of a stable complex ion, $Cu\cdot4\ddot{N}H_3$. According to the author's observations, this view is quite untenable.

180. "The colouring matters of the stilbene group. Part III."
By Arthur George Green and Percy Field Crosland.

In previous communications (*Trans.*, 1904, **85**, 1424, 1432) it has been shown that the first action of caustic alkalis on *p*-nitrotoluenesulphonic acid is the production of an unstable and easily oxidisable dinitrosostilbenedisulphonic acid.

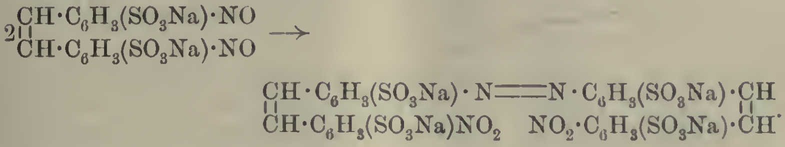
In order to study the subsequent transformation of this intermediate product by which dyestuffs of the stilbene series are produced, typical colouring matters of this class, namely, stilbene yellow 8G and 4G, direct yellow, and Mikado orange, were submitted to examination by the following methods:

A. Estimation of the quantity of hydrogen required to reduce the dyestuff to diaminostilbenedisulphonic acid, employing for this purpose titration with standard titanium trichloride.

B. Estimation of the ethylene groups by determining the quantity of standard permanganate required to oxidise the dyestuffs to aldehydes in cold dilute aqueous solution.

C. Isolation and characterisation of the aldehydes formed.

The results obtained agree with the assumption that in the second stage of transformation condensation takes place between two molecules of the intermediate dinitroso-compound in the following manner:



$$2\,\begin{matrix}\mathrm{CH\cdot C_6H_3(SO_3Na)\cdot NO}\\ \|\\ \mathrm{CH\cdot C_6H_3(SO_3Na)\cdot NO}\end{matrix} \longrightarrow \begin{matrix}\mathrm{CH\cdot C_6H_3(SO_3Na)\cdot N} & = & \mathrm{N\cdot C_6H_3(SO_3Na)\cdot CH}\\ \| & & \| \\ \mathrm{CH\cdot C_6H_3(SO_3Na)NO_2} & & \mathrm{NO_2\cdot C_6H_3(SO_3Na)\cdot CH}\end{matrix}$$

The dinitroazodistilbenedisulphonic acid thus produced represents the structure of the greenest yellow of the series. The redder yellows and oranges are formed therefrom by the reduction of the two nitro-groups, first to an azoxy- and finally to an azo-group. The stilbene yellows 8G and 4G were proved to consist almost entirely of sodium dinitroazodistilbenedisulphonate. Direct yellow is less pure, but appears to consist substantially of sodium azoxyazodistilbenedisulphonate. Mikado orange, which could not be obtained entirely pure, gave results which approximate to those required for the diazostilbenedisulphonate.

It appears, therefore, that all the dyestuffs of the stilbene series are true azo-compounds. Their chromophor being an azo-group, their dyeing properties are now satisfactorily explained. They differ, however, from most other azo-dyestuffs in the entire absence of auxochrome groups.

181. "Interaction of succinic acid and potassium dichromate. Note on a black modification of chromium sesquioxide." By Emil Alphonse Werner.

When a mixture of finely-powdered potassium dichromate (1 mol.) and succinic acid (6 mols.) is heated, interaction takes place a few degrees above the boiling point of the acid (181°). A compound having the composition $Cr_4(C_4H_4O_4)_5,7\,H_2O$ is formed, which has not the properties of a chromo-organic acid. It is practically insoluble in water, and on ignition in air leaves a residue of chromium sesquioxide which is black. The chromium hydroxide produced from it by decomposition with sodium hydroxide also leaves a jet-black modification of the sesquioxide after ignition.

182. "Derivatives of polyvalent iodine. The action of chlorine on organic iodo-derivatives, including the sulphonium and tetra-substituted ammonium iodides." By Emil Alphonse Werner.

Experiments have been made with the object of ascertaining if organic iodo-compounds other than the immediate derivatives of benzene and its homologues can form addition compounds with chlorine corresponding to the iodoso-chlorides.

Iodothiophen, C_4H_3IS ($S:I=1:2$), and di-iodo-thiophen, $C_4H_2I_2S$, m. p. 40°, behave like open-chain compounds; on the other hand, tetraiodopyrrole, $C_4NH\cdot I_4$, forms the additive compounds $C_4NH\cdot I_4Cl_4$ and $C_4NH\cdot I_4Cl_3$ (m. p. 158°).

A few new iodoso-derivatives of benzene have been prepared. By the action of chlorine on the sulphonium and tetra-substituted ammonium iodides, compounds of the type $RCl\cdot ICl_3$ have been obtained, from which the more stable compound of the general formula $RCl\cdot ICl$ can be produced either by the action of heat or by treatment with a solution of sodium hydroxide.

The following *compounds* were described and their constitution discussed:

$(CH_3)_3SCl\cdot ICl_3$ and $(CH_3)_3SCl\cdot ICl$ (m. p. 103°).
$C_2H_5(C_3H_7)_3NCl\cdot ICl_3$ and $C_2H_5(C_3H_7)_3NCl\cdot ICl$ (m. p. 94°).
$(C_2H_5)C_5H_5NCl\cdot ICl_3$ and $(C_2H_5)C_5H_5NCl\cdot ICl$ (m. p. 35°).
$(CH_3)_4NCl\cdot ICl$ (m. p. 217°) and $(C_2H_5)_4NCl\cdot ICl$ (m. p. 98°).

183. "The so-called 'benzidine chromate,' and allied substances." By James Moir.

This remarkable substance, which resembles cœrulignone very closely, resulted on mixing solutions of benzidine and chromium trioxide. The author finds that it is the chromate, not of benzidine, but of a complex oxidation product of the latter, which has apparently the formula $C_{60}H_{46}N_{10}$. It behaves like cœrulignone towards sulphuric acid and towards sulphites, giving an intense crimson coloration with the former, and yielding *benzidine-2-monosulphonic acid* with the latter. The colour-base, $C_{60}H_{46}N_{10}$, appears to have resulted from the condensation of 3 molecules of diphenoquinone-di-imine (*Ber.*, 1905, **38**, 1232) with two of benzidine, in somewhat the same manner as dianilinoquinone-dianil arises from quinone and aniline. On treating with ammonia, only one molecule of benzidine separated from the C_{60} complex, and by the action of potassium sulphite, 3 molecules of benzidinesulphonic acid were produced. "Benzidine chromate" contains 4 molecules of chromic acid, but the author has also prepared a substance containing nearly twice as much chromium, which is either $C_{60}H_{46}N_{10}\cdot 2H_2Cr_4O_{13}$ or merely diphenoquinone-di-imine sesquichromate, $C_{12}H_{10}N_2 + 1\frac{1}{2}CrO_3$.

By heating 3 : 3′-dibromo-5 : 5′-tolidine with chromic acid, a green homologue of "benzidine chromate" was obtained. Its analysis agrees with the formula $C_{60}H_{28}(CH_3)_{10}N_{10}Br_8 + 9H_2CrO_4$, which would be expected from the constitutional formula put forward by the author for "benzidine chromate."

The "ferricyanide of benzidine" has also been investigated. It is similar to and contains the same colour-base as the "chromate," having the formula $C_{60}H_{46}N_{10} + 2H_3Fe(CN)_6$. The action of ammonia resulted in the separation of very little benzidine, giving chiefly another dark colour-base and ammonium ferricyanide.

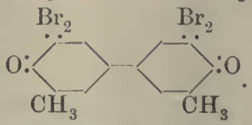
184. "New derivatives of diphenol (4 : 4′-dihydroxydiphenol)."

By James Moir.

By the sulphonation of diphenol the author has prepared the 3 : 3′-*disulphonic acid*, the 3 : 5 : 3′-*trisulphonic acid*, and the 3 : 5 : 3′ : 5′-*tetrasulphonic acid*.

With chlorosulphonic acid, diphenetole yielded (*a*) 4 : 4′-*diphenetole*-3-*sulphonic acid*, (*b*) 4 : 4′-*diphenetole*-3 : 3′-*disulphonic acid*, and (*c*) an indifferent *substance* containing chlorine and sulphur.

On brominating Schütz's dinitrodiphenol, a *dibromodinitrodiphenol* melting at 237° was obtained, and from dicresol the 5 : 5′-*dibromodicresol* melting at 185° was prepared; this combines with excess of bromine to form a scarlet substance analogous to tribromophenol bromide, and possessing the constitution



The *dibenzoate* of diphenol prepared by the Schotten-Baumann method melts at 241°.

185. "On the interaction of the alkyl sulphates with the nitrites of the alkali metals and metals of the alkaline earths."

By Prafulla Chandra Râу and Pañchānan Neogi.

By the interaction of the sodium, potassium, barium, and calcium salts of ethyl sulphuric acid and the nitrites of the alkali metals and metals of the alkaline earths both ethyl nitrite and nitroethane were formed. In the case of potassium ethyl sulphate and potassium or sodium nitrite, small quantities of nitrobutane were also obtained.

186. "The electrolytic preparation of dialkyldisulphides. Preliminary note." By Thomas Slater Price and Douglas Frank Twiss.

By the electrolysis of a concentrated aqueous solution of ethyl sodium thiosulphate, commonly known as Bunte's salt (*Ber.*, 1874, **7**, 646), diethyldisulphide is formed at the anode, and separates as an oily liquid on the surface of the electrolyte. The electrolysis was carried out in a beaker, the cathode consisting of a sheet of platinum foil lying close to the sides of the beaker, the anode being a piece of stout platinum wire. The solution contained a quantity of sodium bicarbonate equivalent to the Bunte's salt taken, otherwise the disulphide was decomposed by the sulphuric acid formed during electrolysis, giving the mercaptan. The current density at the anode was 100 amperes per sq. cm., and the yield was more than 50 per cent. of the theoretical. The disulphide obtained distilled almost completely at 152°. It forms a *compound* with silver nitrate, which on analysis gave $Ag = 36{\cdot}93$. $(C_2H_5)_2S_2,AgNO_3$ requires $Ag = 36{\cdot}95$ per cent.

Similar results were obtained by electrolysing solutions of benzyl sodium thiosulphate (Purgotti, *Gazzetta*, 1890, **20**, 24), dibenzyldisulphide being produced in a yield of more than 80 per cent.; this was crystallised from alcohol and melted at 70°. Analysis of the *compound* with silver nitrate gave $Ag = 26{\cdot}3$. $(C_6H_5CH_2)_2S_2,AgNO_3$ requires $Ag = 26{\cdot}0$ per cent.

This reaction is being more thoroughly investigated and extended to the preparation of other disulphides.

187. "The direct union of carbon and hydrogen at high temperatures." By John Norman Pring and Robert Salmon Hutton.

Previous work has been limited to a study of this reaction at 1200—1350° and to the investigation of the products obtained when a carbon arc is maintained in hydrogen. The authors have now supplemented these observations by working at intermediate temperatures.

For this purpose, a special form of apparatus was devised in which carbon rods, supported at the centre of a glass or metal vessel containing hydrogen, were heated to any desired temperature by the resistance which they offer to the passage of an electric current. By carrying out experiments at gradually increasing temperatures, it was found that traces of acetylene were already formed at 1700°, and the percentage of acetylene increased fairly uniformly with the temperature up to 2800°, which was the maximum point attained. The production of acetylene at these comparatively low temperatures and independently of any of the complicated electrical phenomena which accompany the arc does not seem to have been noted previously.

The formation of methane was also carefully studied at temperatures from 1000° upwards; the amounts found were in most cases much below those indicated by Bone and Jerdan (*Trans.*, 1897, **71**, 41; 1901, **79**, 1042), and seemed to diminish as the purity of the carbon increased.

188. "The action of nitrogen sulphide on certain metallic chlorides." By Oliver Charles Minty Davis.

When nitrogen sulphide dissolved in dry chloroform is added to the tetrachlorides of tin and titanium, the pentachlorides of antimony and molybdenum, and also tungsten hexachloride dissolved in the same solvent, interaction readily takes place. With stannic chloride, antimony pentachloride, and molybdenum pentachloride, the *compounds* formed are represented by the formulæ $SnCl_4,2N_4S_4$, $SbCl_5,N_4S_4$, and $MoCl_5,N_4S_4$ respectively, but the chlorides of tungsten and titanium are first reduced before combining with nitrogen sulphide, finally giving *compounds* having the formulæ $WoCl_4,N_4S_4$ and Ti_2Cl_6,N_4S_4. These substances are decomposed on exposure to moist air with varying degrees of rapidity, and less readily when preserved beneath dry chloroform. Negative results were obtained with the trichlorides of iron, antimony, and arsenic.

189. "The determination of halogen." By James Moir.

The substance to be analysed having been weighed directly into a tall nickel crucible, ten drops of water and five to seven "pastilles" of pure potassium hydrate are added and the mixture is stirred with a platinum wire while it is heated on the steam-bath; when it is uniform, from 0·5 to 1 gram of finely-powdered potassium permanganate is stirred in, in small portions at a time; the mixture is then heated on the steam-bath until dry, being watched in case frothing occurs; it is afterwards heated slowly to visible redness or until the glowing caused by the interaction between separated carbon and manganese dioxide is over. The cool crucible is placed in a warm dilute solution of potassium bisulphite; the solution is then carefully acidified with acetic acid and filtered directly into a solution of silver nitrate. The silver halide may be worked up with nitric acid in the usual manner, or the cooled crucible may be placed in water and the solution carefully acidified with acetic acid until the manganate is converted into permanganate; the latter is then destroyed by means of barium dioxide, the filtered solution neutralised with sodium bicarbonate and titrated, using chromate as indicator.

ERRATUM.

PROCEEDINGS, 1906, p. 203.

In the third line from top *for* "**pentamethylen**" *read* "**polymethylene.**"

At the next Ordinary Meeting, on **Thursday**, November **1st**, 1906, at **8.30** p.m., the following papers will be communicated:

"A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency." By W. Barlow and W. J. Pope.

"The explosive combustion of hydrocarbons. II." By W. A. Bone, J. Drugman, and G. W. Andrew.

"Contributions to the theory of solutions. I. The nature of the molecular arrangement in aqueous mixtures of the lower alcohols and acids of the paraffin series. II. Molecular complexity in the liquid state. III. Theory of the intermiscibility of liquids." By J. Holmes.

"The hydrolysis of nitrocellulose and nitroglycerol." By O. Silberrad and R. C. Farmer.

"The determination of the rate of chemical change by measurement of gases evolved." By F. E. E. Lamplough.

"Experiments on the synthesis of the terpenes. Part IX. The preparation of δ-ketohexahydrobenzoic acid (δ-keto*cyclo*hexanecarboxylic acid) and of γ-keto*cyclo*pentanecarboxylic acid." By F. W. Kay and W. H. Perkin, jun.

"Experiments on the synthesis of the terpenes. Part X. Synthesis of Δ^1-*m*-menthenol(8) and of carvestrene." By W. H. Perkin, jun., and G. Tattersall.

"Some derivatives of catechol, pyrogallol, benzophenone and of other substances allied to the natural colouring matters." By W. H. Perkin, jun., and C. Weizmann.

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Issued 12/11/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 315.

Thursday, November 1st, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society through the death, on October 19th, of Geh. Rath Professor Fedor Beilstein, who was elected an Honorary and Foreign Member on February 1st, 1883.

Messrs. H. R. Cooper, F. E. E. Lamplough, and W. H. Rawles were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Richard Abegg, Ph.D., Landbergstrasse 4, Breslau, Germany.
William Heath Bayliss, Brewery House, Ashwell, Herts.
Charles George Edgar Farmer, 16, Herbert Crescent, S.W.
David Paton Grubb, B.Sc., Windsor Hill, Newry.
John Hamer, 44, Sugden Road, Clapham Common, S.W.
Alexander Edmund Middleton, 112, South Park Road, Wimbledon, S.W.
Arthur Higgs Morris, 77, Beverly Road, Bolton, Lancs.
Arthur Percival Newton, B.Sc., Red Cot, Coulsdon, Surrey.
Benjamin Dawson Porritt, 33, South Park Hill, South Croydon.
Herbert Stanley Redgrove, 137—140, Tottenham Court Road, W.
William R. R. Starling, 23, Magdalen Road, Norwich.

Of the following papers, that marked * was read:

***190. "A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency." By William Barlow and William Jackson Pope.**

The authors represent atoms in the combined state by "spheres of influence," and inquire how such spheres can be close-packed in a homogeneously symmetrical manner so as accurately to simulate crystalline compounds. An examination of the geometrical properties of close-packed assemblages of spheres shows that the atoms of the elements must be represented by spheres of influence directly proportional in volume to their fundamental valencies, and that a close-packed assemblage built up of spheres of the appropriate sizes, so as to represent some particular compound, can be partitioned into units identical with the chemical molecule, and possesses symmetry and dimensions compatible with those of the crystalline substance.

A detailed inquiry concerning benzene, triphenylmethane, naphthalene, anthracene, and their derivatives, shows that, with the inclusion of the above assumption, all the requisite data are available for precisely determining the configuration of the benzene molecule. The configuration deduced is in accordance with the crystallographic and chemical evidence and leads to an explanation of the meta-, ortho-para-law of substitution, and of other previously unexplained features of the chemistry of aromatic substances.

In addition to the geometrical property, which demonstrates that valency is a volume relation, it is shown that close-packed homogeneous assemblages of spheres possess others which lead to simple physical interpretations of multivalency and tautomerism. It is also indicated that ethylenic and acetylenic bonds and isomerism have complete analogues in peculiarities of homogeneous assemblages of spheres.

The relations briefly indicated above have been worked out in detail and are shown to be in entire agreement with the quantitative evidence afforded by the crystallographic measurements of the compounds concerned.

DISCUSSION.

Prof. ARMSTRONG, after expressing his opinion that the communication was one of altogether fundamental importance, in the first place referred to it as showing the extreme value to chemists of the study of crystallography—a subject of which hitherto relatively far too little notice had been taken. It was to be hoped that a sense of proportion would begin to prevail and that the study of form would now receive proper attention. The success with which the authors appeared to have correlated crystalline form with structure was very remarkable especially their determination of the manner in which water or other complexes became attached in one particular direction to a molecule—slabwise. Perhaps the most important feature of the communication and the most interesting to chemists, at present, was the manner in which valency was accounted for as a volume property and a very ingenious explanation given of varying valency. In particular, he had been struck, when discussing the work with Prof. Pope, by the explanation which was given of the departure from the ordinary law of increase or decrease of valency by two units at a time (the law of odd or even valency) observed in the case of the simpler compounds of an element—as in the oxides of nitrogen, for example, Hitherto chemists had been forced to deal with variation of valency simply as a fact; they were now, for the first time, presented with an explanation of the cause of variation and of the manner in which this was effected.

Another point of extreme interest was the view put forward that it could not be supposed that elements preserved a constant "atomic volume," since it was often found, in cases in which the introduction of a radicle involved an alteration in volume, that the complex changed as a whole, the original form being preserved, alteration taking place proportionally along each axis.

Like the theory of structure at present in use, the mode of treatment now advocated did not enable us to deal with the dynamical side of chemical phenomena; it was to be regarded as an amplification of that theory, not as over-riding it or as proving it to be in any way inconsequent. The opportunities it afforded of discussing problems which had eluded our grasp hitherto appeared to be very numerous.

Mr. JOHN CASTELL-EVANS asked whether he had rightly understood Prof. Pope's statement relative to the substitution of two or more spheres for one? As he understood it, Prof. Pope seemed to say "that if from a closely packed aggregation of spheres one individual sphere of volume m be removed, the resulting cavity could be filled by m spheres each of unit volume and the 'close packing' be still preserved." This is not the case; if a cube, say, be described about the sphere of volume m, then into this cube m unit spheres could be packed, but certainly not into the cavity left by the removal of the original sphere.

Mr. BALY pointed out that the particular assemblage of atoms adopted by Prof. Pope for the benzene molecule would only exist in the benzene crystal. In the liquid state the molecule of benzene would probably not exist in the rigid condition pictured by the authors; there would seem to be no doubt that the molecule possesses an inherent tendency to vibrate, this tendency being dependent very largely on the temperature. Probably the melting point of a crystal marks the temperature at which the tendency to vibrate on the part of the molecules overcomes the elastic energy of the crystalline form. Inasmuch as the reactions of benzene and its compounds usually take place with the substance in solution or in the liquid state, any property based only on the rigid structure in the crystal would not necessarily hold good. For example, the authors base an explanation of the ortho-, meta-, and para-substitution on this rigid structure. Owing to the dynamic condition obtaining during reactions this explanation would seem to fall to the ground.

Mr. WOOLHOUSE expressed surprise that in the complex $NaNO_3$ the element C with a volume of 4 could replace the N with a volume of 3, and that the element Ca with a volume of 2 could replace the Na with a volume of 1, and yet calcite could have such a similarity of crystalline form, as it is known to have, to that of sodium nitrate.

Although the replacement of N by C might leave the x, y, z ratios the same in spite of the increase of each, still the substitution of Ca for Na must result in an alteration of shape of the complex, resulting in the increase of at least one of these values.

Prof. MIERS, speaking as a crystallographer, stated his conviction that the new theory propounded by the authors was destined to be of immense value in the problems of crystal structure.

Crystallographers were accustomed to treat these as statical problems, and (largely owing to the researches of Mr. Barlow) feel fairly confident that they now know something of the manner in which the crystalline material is arranged. The principle of packing was liable to suspicion so long as there was no clue to the nature of the units, but had now acquired quite a new meaning with the valency volumes to indicate the dimensions of the bodies to be packed: so that we might now hope to realise a true model of the crystal structure.

The case of the Humite group, in which the increase of an axis is absolutely proportional to the valency volume of the introduced radicle, was in his opinion a very convincing one. The theory was one of profound interest to all students of crystals.

Dr. TUTTON said that he considered a notable advance had been made by the authors of this paper, which furnished another example of the advantages of the study of crystallography by chemists, an object which he had long been striving to further. There appeared to be three salient points in the work, the results of which were laid before the Society that evening. The first was the emphasis of the individual influence of the atom as distinguished from the properties of the molecule as a whole, and the influence of certain predominating atoms in particular in determining those properties. This had been one of the chief results of his (Dr. Tutton's) own work on the sulphates and selenates, and the present work was based on that now absolutely incontrovertible foundation. The second point was that the teaching of the "topic axial ratios," introduced to the Society by him (Dr. Tutton) in the year 1894, simultaneously with and independently of Dr. Muthmann in the *Zeitschrift für Krystallographie*, was now advanced by the authors of the present paper a step further, inasmuch as in the formulæ for those ratios the term V respecting the molecular volume would now be replaced by W, the valency volume. Not only did this involve the remarkable geometrical explanation of valency which had been explained to them, but, and this was the third point which the speaker desired to emphasise, it enabled the ratios in question to be no longer confined to exhibiting in a highly instructive manner the structural relationships between the members of the same series of isomorphous compounds, but connected various series together and indeed, in general, enabled comparisons to be made between compounds of totally dissimilar, as well as of similar, nature. It was, therefore, obvious that a great advance in the correlation of chemical composition and crystalline form had been made.

Mr. W. Barlow pointed out that the spheres employed to picture the equilibrium conditions of the atoms must not be regarded as actually existent in nature; the actual spheres of influence of the atoms are not supposed to be separated by interstices, and the models are merely the best means that the authors have found for expressing, in a concrete form, the results of their researches. The balls used to represent the atomic spheres of influence should be made of solid soft india-rubber, so as to be elastic and deformable, but not compressible, and the close-packed assemblages, composed of balls of appropriate sizes, should be compressed to an extent which will practically annul the interstices.

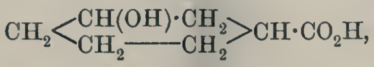
Prof. Pope stated that in the substitutions referred to by Mr. Evans, the interstitial space is regarded as available for occupation by the new contents of the cavity. The total space available for the substituting spheres is thus not spherical, but of the irregular shape bounded by the curved surfaces of the enveloping spheres.

The series of substitutions as a result of which the $NaNO_3$ assemblage is converted into that of $CaCO_3$ can be performed so that the crystalline form changes but slightly, although the equivalence parameters x, y, and z increase, but remain equal to one another in accordance with the rhombohedral symmetry.

It is not claimed that the rigid assemblage of solid spheres represents accurately the condition of crystalline benzene; the spheres of atomic influence may well be regarded as domains of considerable dynamic activity. The existence of "liquid crystals" suggests that much symmetry of arrangement occurs transiently in liquids generally, and the uniformity of chemical reaction in solution must be largely attributable to symmetry of arrangement as between reacting molecules. There is no reason to suppose that considerable change in molecular configuration attends the liquefaction of benzene; as the suggested mode of regarding the meta- and ortho-para-law only postulates symmetry of arrangement, it appears to be perfectly valid.

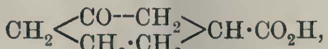
191. "Synthesis of carvestrene. Preliminary notice."
By William Henry Perkin, jun., and George Tattersall.

When *m*-hydroxybenzoic acid is reduced by means of alcohol and sodium, it is converted into hexahydro-*m*-hydroxybenzoic acid,



$$\mathrm{CH_2}{<}\begin{matrix}\mathrm{CH(OH)\cdot CH_2}\\ \mathrm{CH_2{-}{-}{-}CH_2}\end{matrix}{>}\mathrm{CH\cdot CO_2H},$$

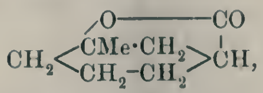
which crystallises from ether and melts at 130—132° (compare Einhorn, *Annalen*, 1896, **291**, 298). Oxidation with potassium bichromate and sulphuric acid converts this hydroxy-acid into *γ-keto-hexahydrobenzoic acid,*



$$\mathrm{CH_2}{<}\begin{matrix}\mathrm{CO{-}{-}CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}{>}\mathrm{CH\cdot CO_2H},$$

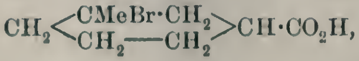
which had previously been obtained only in the form of a syrup. (Baeyer and Tutein, *Ber.*, 1889, **22**, 2182; Einhorn, *loc. cit.*, p. 304; Goodwin and Perkin, *Trans.*, 1905, **87**, 852). It crystallises from benzene in glistening prisms, melts at 75—76°, distils at 210° (25 mm.), and yields a *semicarbazone* melting at 182—183° with decomposition.

Ethyl γ-ketohexahydrobenzoate (b. p. 150° under 30 mm.) reacts with magnesium methyl iodide with the formation of the *lactone* of *γ-hydroxyhexahydro-*m*-toluic acid,*



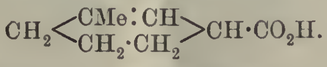
$$\mathrm{CH_2}{<}\begin{matrix}\overset{\diagup\mathrm{O}\text{———————}\mathrm{CO}}{\mathrm{CMe\cdot CH_2}}\\ \mathrm{CH_2{-}CH_2}\end{matrix}{>}\overset{|}{\mathrm{C}}\mathrm{H},$$

a colourless oil which distils at 145° (20 mm.), and when heated with hydrobromic acid is quantitatively converted into *γ-bromohexahydro-*m*-toluic acid,*



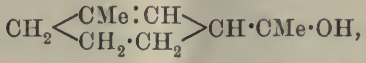
$$\mathrm{CH_2}{<}\begin{matrix}\mathrm{CMeBr\cdot CH_2}\\ \mathrm{CH_2{-}{-}CH_2}\end{matrix}{>}\mathrm{CH\cdot CO_2H},$$

which, so far, has only been obtained in the form of a syrup. It readily loses hydrogen bromide when treated with pyridine, and is converted into a *tetrahydro*-m-*toluic acid* of boiling point 142—144° (15 mm.), which probably has the constitution



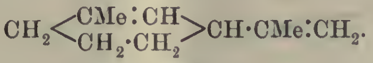
$$CH_2<\begin{matrix}CMe{:}CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CO_2H.$$

The *ester* of this acid (b. p. 128° under 60 mm.) reacts readily with magnesium methyl iodide, and is almost quantitatively converted into Δ^{1}·m-*menthenol*(8),



$$CH_2<\begin{matrix}CMe{:}CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CMe\cdot OH,$$

which had not previously been prepared. This tertiary alcohol distils at 110—112° (30 mm.), has a pleasant odour of menthol and terpineol, and when digested with potassium hydrogen sulphate is almost quantitatively decomposed with elimination of water and formation of *carvestrene*,



$$CH_2<\begin{matrix}CMe{:}CH\\CH_2\cdot CH_2\end{matrix}>CH\cdot CMe{:}CH_2.$$

The hydrocarbon thus obtained distilled at 179—180° and yielded a *dihydrochloride*, $C_{10}H_{16},2HCl$, melting at 52·5°, and a *dihydrobromide*, $C_{10}H_{16},2HBr$, melting at 48°. Its solution in acetic anhydride was coloured deep blue by the addition of sulphuric acid.

Since these properties coincide exactly with those of carvestrene, which Baeyer (*Ber.*, 1894, **27**, 3488) first prepared by the distillation of vestrylamine hydrochloride, and which Baeyer and Villiger (*Ber.*, 1898, **31**, 1402) subsequently proved to belong to the *m*-cymene series, there can be little doubt that the above experiments are to be regarded as a synthesis of this important terpene.

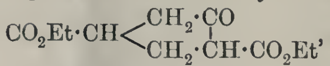
192. "Some derivatives of catechol, pyrogallol, benzophenone, and of substances allied to the natural colouring matters." By William Henry Perkin, jun., and Carl Weizmann.

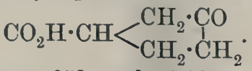
This communication contains the description of the preparation and properties of a number of new substances obtained at different times in connection with researches on the constitution of brazilin, hæmatoxylin, and other natural colouring matters.

193. "Experiments on the synthesis of the terpenes. Part IX. The preparation of *cyclo*pentanone-3-carboxylic acid and of *cyclo*hexanone-4-carboxylic acid (δ-ketohexahydrobenzoic acid)." By Francis William Kay and William Henry Perkin, jun.

When ethyl butane-αβδ-tricarboxylate,

$$CO_2Et\cdot CH_2\cdot CH(CO_2Et)\cdot CH_2\cdot CH_2\cdot CO_2Et,$$

is heated with sodium and the product acidified, it yields *ethyl* cyclo*pentanone*-2 : 4-*dicarboxylate*,  $CO_2Et\cdot CH<\begin{matrix}CH_2\cdot CO\\ CH_2\cdot CH\cdot CO_2Et\end{matrix}$, a colourless oil, which distils at 166° (18 mm.), and, when digested with dilute sulphuric acid, is readily hydrolysed with elimination of carbon dioxide and formation of cyclo*pentanone-3-carboxylic acid*,

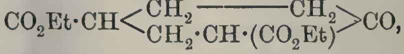


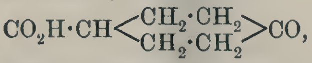
$$CO_2H\cdot CH<\begin{matrix}CH_2\cdot CO\\ CH_2\cdot CH_2\end{matrix}.$$

This new acid melts at 65°, and yields an *oxime* (m. p. 141°) and a *semicarbazone* (m. p. 195°).

When ethyl pentane-$\alpha\gamma\epsilon$-tricarboxylate,

$$CO_2Et\cdot CH_2\cdot CH_2\cdot CH(CO_2Et)\cdot CH_2\cdot CH_2\cdot CO_2Et,$$

is treated with sodium, it is converted in a similar manner into *ethyl* cyclo*hexanone*-2 : 4-*dicarboxylate*,  $CO_2Et\cdot CH<\begin{matrix}CH_2 & \text{———} & CH_2\\ CH_2\cdot CH\cdot(CO_2Et)\end{matrix}>CO$, which distils at 180° (20 mm.), and, on hydrolysis with dilute sulphuric acid, yields δ-ketohexahydrobenzoic acid,



$$CO_2H\cdot CH<\begin{matrix}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{matrix}>CO,$$

this method of preparation being much more convenient than that previously described (*Trans.*, 1904, **85**, 418). The authors wish to reserve the further investigation of the substances described in this preliminary communication.

194. "The hydrolysis of 'nitrocellulose' and 'nitroglycerine'."

By Oswald Silberrad and Robert Crosbie Farmer.

The authors have studied the hydrolysis of nitrocellulose, nitroglycerine, and mixtures of the two in the form of cordite and ballistite. The hydrolysis is complicated by the simultaneous reduction of the nitric acid, as shown by (1) the formation of large quantities of nitrites, (2) the degradation of the cellulose and glycerol to hydroxy-acids, &c., (3) the abnormally high saponification equivalents found (9·2 to 9·5 for pentanitrocellulose and 4·85 for nitroglycerine), (4) the abnormality of the velocity curves. Intermediate products are formed which are gradually acted on by the alkali; these are practically insoluble in water and do not give rise to free acid when left in contact with water for several days.

With the aid of velocity determinations with varying quantities of gun-cotton, a formula was deduced whereby the velocity was calculated with which the reaction would occur if perfect diffusion took place. The following results were obtained when gun-cotton was suspended in 400 c.c. of acid or alkali at 37·8°.

Grams of gun-cotton.	Concentration of H or OH ions.	Velocity (gram-equiv. of acid liberated per hour).	
		Calculated.	Found.
(1) *Hydrolysis by Baryta Solution.*			
3·10	0·197	0·0035	0·0033
4·97	0·191	0·0051	0·0053
20·42	0·096	0·0070	0·0071
22·10	0·189	0·0144	0·0142
∞	1·000	0·168	—
(2) *Hydrolysis by Nitric Acid.*			
5·10	0·821	0·00018	0·00018
10·00	0·821	0·00022	0·00021
20·35	0·821	0·00025	0·00024
∞	1·000	0·000347	—

From the limiting velocities thus determined, it was calculated that the hydrolysis of nitrocellulose will take place with the minimum velocity when the concentration of the hydrogen ions is $3·7 \times 10^{-6}$ and that of the hydroxyl ions $7·8 \times 10^{-9}$ gram-equivalents per litre. Under these conditions, the hydrolysis will proceed with such a velocity as to liberate $5·6 \times 10^{-5}$ gram-equivalents of acid per litre of water per year.

195. "The acidic constants of some ureides and uric acid derivatives." By John Kerfoot Wood.

The investigation was undertaken with the object of determining the influence of other groups on the acidity of the imino-group. In compounds which contain the grouping ·CO·NH·CO·NH·CO·, there appears to be a mutual reinforcement of the imino-groups, analogous to the reinforcement of the carboxyl groups in succinic acid. Divergent results were obtained with barbituric and *C*-ethylbarbituric acids, the dissociation constants of which are many times greater than those of the other substances investigated; this high acidity is due to the CH_2 or $CH(C_2H_5)$ group.

196. "The affinity constants of xanthine and its methyl derivatives." By John Kerfoot Wood.

The author described the results of determinations of the basic and acidic constants of xanthine, 7-methylxanthine, the three isomeric dimethylxanthines, and caffeine. There is no great variation in the values of the basic constants, but a very striking difference in the values of the acidic constants is to be noticed. The dimethylxanthines, especially paraxanthine and theophylline, are stronger acids than any of the other members of the series. Moreover, when the results for the three dimethylxanthines are compared amongst themselves, it is seen that they are not in agreement with the constitutions of the isomerides. The conclusion is drawn that these results are to be explained by a stereochemical influence exerted by the two methyl groups, the influence varying in magnitude according to the positions in the xanthine nucleus which the methyl groups occupy.

197. "The explosive combustion of hydrocarbons. II." By William Arthur Bone, Julien Drugman, and George William Andrew.

The authors have further examined the phenomena associated with the "inflammation" of mixtures of ethane or ethylene and oxygen corresponding to $C_2H_6+O_2$ and $3C_2H_4+2O_2$ respectively, by a method which allows of discrimination between the various products according as they arise at an earlier or later stage in the flame. In each case, steam, aldehydes, ethylene, and acetylene are prominent during the initial stages of combustion, whilst carbon is a later product. Steam is so rapidly decomposed by carbon at high temperatures that prolonged duration of the flame diminishes the quantity of water which separates on cooling.

The authors have also succeeded in producing "detonation" in mixtures of ethane, or butane, and oxygen corresponding to $C_2H_6+O_2$ and $C_4H_{10}+2O_2$ respectively, at initial pressures of 900 mm. and upwards. The mechanism of combustion under these conditions does not, however, appear to be essentially different from what it is in ordinary flames.

198. "Contributions to the theory of solutions. I. The nature of the molecular arrangement in aqueous mixtures of the lower alcohols and acids of the paraffin series. II. Molecular complexity in the liquid state. III. Theory of the intermiscibility of liquids." By John Holmes.

The author has determined the relative densities of mixtures of carbon disulphide with ethyl- and *n*-propyl-alcohols respectively, and of pyridine with water and ethyl alcohol.

From a consideration of the nature of the volumetric changes occurring in these and other mixtures of liquids, it is concluded that the sphere of activity of a molecule is not an invariable function of the molecular volume, as ascertained from its molecular weight and specific gravity.

On these changes the author bases a theory of intermiscibility, depending on differences in the degree of repulsion between liquid molecules.

199. "The relation between natural and synthetical glycerylphosphoric acids. Part II." By Frank Tutin and Archie Cecil Osborn Hann.

With the object of ascertaining the nature of the natural and synthetical glycerylphosphoric acids, the authors have synthesised the unsymmetrical or α-acid, $OH\cdot CH_2\cdot CH(OH)\cdot CH_2\cdot O\cdot PO_3H_2$, and the symmetrical or β-acid, $(CH_2\cdot OH)_2{:}CH\cdot O\cdot PO_3H_2$, and have compared the barium and brucine salts with the corresponding salts of the natural and synthetical acids.

α-Glycerylphosphoric acid was prepared by the action of phosphoric acid on β-dichlorohydrin and subsequent hydrolysis of the product.

β-Glycerylphosphoric acid was prepared by the hydrolysis of *β-diglycerylphosphoric acid* (m. p. of calcium salt, 249—250°), which had been obtained by the action of phosphoryl chloride on α-dichlorohydrin and subsequent hydrolysis of the product.

The racemised natural acid was prepared by the hydrolysis of egg lecithin with hot baryta solution.

The synthetical acid was obtained from glycerol and phosphoric acid under such conditions as had been previously shown to give only the mono-ester.

The barium salts of these acids differ considerably in appearance, solubility, and in the amount of water they contain. The brucine salts differ in the amount of their water of crystallisation, but all melt at 157—159°, and not at 181°, as stated by Carré (*Compt. rend.*, 1903, 137, 1070).

It is concluded from the results of this investigation that the natural and synthetical glycerylphosphoric acids are differently constituted mixtures of the α- and β-acids.

200. "Thiocarbonic acid and some of its salts." By Ida Guenevere O'Donoghue and Zelda Kahan.

Thiocarbonic acid has been prepared by the cautious addition of calcium thiocarbonate to cold concentrated hydrochloric acid. It is a heavy, red oil, boiling with decomposition at 50°, and on distillation under diminished pressure decomposes into carbon disulphide, hydrogen sulphide, and sulphur. Thiocarbonic acid expels carbon dioxide from carbonates, and on treatment with metallic sodium or potassium yields the corresponding salts. The normal metallic thiocarbonates are formed by the action of the salts of weak acids on thiocarbonic acid, and are constituted similarly to the corresponding carbonates. The acid has therefore the formula H_2CS_3. The salts are very unstable both in air and in a vacuum, some decompose quantitatively into carbon disulphide and metallic sulphide, whilst others give, under similar conditions, a variety of basic compounds.

201. "Studies in optical superposition. Part II." By Thomas Stewart Patterson and John Kaye.

Di-*l*-menthyl *l*-tartrate, di-*l*-menthyl diacetyl-*l*-tartrate, and sodium *l*-menthyl *l*-tartrate have been prepared and examined in regard to their optical activity, both in the homogeneous condition, so far as possible, and also in solution. The results are discussed in connection with the problem of optical superposition.

202. "Optically active dihydrophthalic acid." By Allen Neville.

When the hydrogen strychnine salt of trans-$\Delta^{3:5}$-dihydrophthalic acid is fractionally crystallised from alcohol, the acid is resolved into its lævo- and dextro-isomerides. These melt at 122° and do not lose weight at 100°. They are readily soluble in alcohol, fairly so in ether or chloroform, and insoluble in water. They have $[\alpha]_D$ about 126° in alcohol and about 140° in chloroform.

Heated with water or alkali, they pass to the optically inactive $\Delta^{2:6}$-modification and, warmed with acetic anhydride, are transformed to the *cis*-$\Delta^{3:5}$-modification of dihydrophthalic acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Alexeyeff, *P.* General principles of organic syntheses. Authorised translation with revision and additions by *J. Merritt* **Matthews.** pp. viii + 246. New York 1906. (*Recd.* 29/9/06.)
From the Publishers: Messrs. John Wiley & Sons.

Berthelot, *Marcellin.* Archéologie et histoire des sciences. pp. 377. Paris 1906. (*Recd.* 23/7/06.) From the Author.

Brown, *S. E.* A practical chemistry note-book for matriculation and army candidates. pp. 47. ill. London 1906. (*Recd.* 28/9/06.)
From the Publishers: Messrs. Methuen & Co.

Church [*Arthur Herbert*]. Church's laboratory guide. A manual of practical chemistry . . . specially arranged for agricultural students. Revised and partly rewritten by *Edward* **Kinch.** Eighth edition. pp. xvi + 349. London 1906. (*Recd.* 5/10/06.)
From Professor E. Kinch.

Grossmann, *J.* Ammonia and its compounds. pp. xi + 151. London 1906. (*Recd.* 28/9/06.)
From the Publishers: Messrs. Harper & Brothers.

Guttmann, *Oscar.* Monumenta Pulveris Pyrii. Reproductions of ancient pictures concerning the history of gunpowder, with explanatory notes. [Explanatory notes, 34 pp. 104 illustrations on 94 pp.] Printed for the Author at the Artists' Press, Balham, S.W. London 1906. (*Reference.*) From the Author.

Handbuch der anorganischen Chemie. Herausgegeben von *R.* **Abegg.** Band III. Abteilung I. pp. x + 466. Leipzig 1906. (*Reference.*) From the Publisher: S. Hirzel.

Institute of Chemistry. A list of official chemical appointments held in Great Britain and Ireland, in India and the Colonies. Compiled . . . by *Richard B.* **Pilcher.** pp. 123. London 1906. (*Recd.* 17/7/06.) From the Institute.

McCrudden, *Francis H.* Uric acid: the chemistry, physiology, and pathology of uric acid and the physiologically important purin bodies; with a discussion of the metabolism in gout. pp. xi + 318. New York [1906]. (*Recd.* 29/9/06.)
From the Publisher: Paul B. Hoeber.

Pellet, *H.* O acido salicylico e a questão dos vinhos Portuguezes no Brazil em 1900. Vertida para Portuguez por *A. J.* **Ferreira da Silva.** pp. xxiii + 521. Coimbra 1906. (*Recd.* 14/8/06.)
From the Translator.

Schryver, *Samuel Barnett.* Chemistry of the albumens. Ten lectures delivered in the Michaelmas Term, 1904, in the Physiological Department of University College, London. pp. 192. London 1906. (*Recd.* 7/10/06.) From the Author.

Smith, *H. Carlton.* Lecture-notes on chemistry for dental students. pp. viii + 273. ill. New York 1906. (*Recd.* 11/7/06.) From the Publishers: Messrs. John Wiley & Sons.

Strunz, *Franz.* Ueber die Vorgeschichte und die Anfänge der Chemie. Eine Einleitung in die Geschichte der Chemie des Altertums. pp. viii + 69. Leipzig und Wien 1906. (*Recd.* 20/8/06.) From the Publisher: Franz Deuticke.

Woods, *Hugh.* Æther: a theory of the nature of æther and of its place in the universe. pp. xii + 100. London 1906. (*Recd.* 13/8/06.) From the Author.

II. *By Purchase.*

American Electrochemical Society. Transactions. Vol. I—III. Philadelphia 1902—3. (*Reference.*)

Ditte, *Alfred.* Étude générale des sels. 2 vols. pp. vii + 304, 383. Paris 1906. (*Recd.* 11/7/06.)

III. *Pamphlets.*

Guarini, *Emile.* L'ozone. pp. 24. Paris [1906].

Losanitsch, *S. M.* Die Grenzen des periodischen Systems der chemischen Elemente. pp. 30. Belgrad 1906.

Mingaye, *John C. H.*, and **White**, *Harold P.* Analyses of artesian and sub-artesian waters in New South Wales. pp. 5. Sydney 1906.

Rydberg, *J. R.* Elektron, der erste Grundstoff. pp. 30. Lund 1906.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 10th December, 1906.

Those Fellows who received grants in December, 1905, or whose grants, allotted in December of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Saturday, 1st December next.

ERRATA.

PROCEEDINGS, 1906, p. 260.

Lines 12 and 13 from top, *for* "disulphide" *read* "ethyl sodium thiosulphate."
„ 13 from top, *for* "'the' mercaptan" *read* "'some' mercaptan."
„ 14 from top, *for* "cm." *read* "dcm."

At the next Ordinary Meeting, on **Thursday**, November 15th, 1906, at **8.30** p.m., the following papers will be communicated :

"The determination of the rate of chemical change by measurement of gases evolved." By F. E. E. Lamplough.

"Xanthoxalanil and its analogues." By S. Ruhemann.

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Issued 23/11/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 316.

Thursday, November 15th, 1906, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. J. Campbell Brown and W. H. Hurtley were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Frank Stanley Benton, Hurstead, Reigate.
John Trevor Cart, B.Sc., A.I.C., 4, Simonside Terrace, Heaton, Newcastle-on-Tyne.
George William Clough, B.Sc., 29, Oseney Crescent, N.W.
Victor George Jackson, 21, Frankfurt Road, Herne Hill, S.E.
Louis Murgatroyd, 1, Carlton Drive, Heaton, Bradford.
Robert Robertson, M.A., D.Sc., F.I.C., 9, Sewardstone Road, Waltham Abbey.
Arthur Henry Salway, Ph.D., B.Sc., 15, Palmerston Road, Forest Gate, E.
Robert Low Smith, 56, Genesta Road, Plumstead, S.E.
William Sandilands Templeton, M.A., B.Sc., Colombo, Ceylon.
Maximilian Toch, 261, West 71st Street, New York City, U.S.A.

A certificate was authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of:

Tarak Nath Majumdar, 37, Lower Chitpore Road, Calcutta, India

Of the following papers, those marked * were read:

***203. "The determination of the rate of chemical change by measurement of gases evolved. Preliminary notice." By Francis Edward Everard Lamplough.**

The most important results of this investigation may be summarised as follows:

When a chemical reaction takes place in solution resulting in the formation of a substance which is gaseous at the ordinary temperature, the solvent becomes supersaturated with the gas.

The degree of supersaturation may be so great that the solvent contains 100 times the normal amount of the gas, and from such a solution the gas is gradually evolved.

The excess of gas so dissolved may be almost entirely expelled in thirty seconds by briskly agitating the liquid.

Investigation of the rate of decomposition of hydrogen peroxide showed that under such conditions of efficient stirring, the rate of evolution of a gas furnishes an accurate and reliable method of investigating reactions of this nature.

The decomposition of diazobenzene chloride was shown to be strictly a unimolecular reaction throughout, the rate of which is independent of the amount of acid present. The value of the constant for the reaction was found to vary with change of temperature, increasing logarithmically with increase of temperature.

The nature of the decomposition of ammonium nitrite most nearly approaches that of a quadrimolecular reaction throughout the extent of decomposition investigated.

The decomposition of formic acid by sulphuric acid is a true unimolecular reaction, and not bimolecular, as it has been hitherto considered.

The reaction between nickel carbonyl and iodine has also been studied.

DISCUSSION.

Dr. CAIN pointed out that Hantzsch had first shown that the value of the constant obtained in measurements of the rate of decomposition of diazo solutions was low at the beginning of an experiment, owing to the solubility of the nitrogen. There was no supersaturation, however, in the solutions used in the experiments by him (Dr. Cain) and Mr. Nicoll, for the deficit in the quantity of nitrogen evolved corresponded to the amount which would ordinarily remain in solution. Moreover, the values obtained for the constants agreed well with those given by Hantzsch, Euler, and other investigators.

Mr. CALDWELL asked if there were any *real* retardation of these reactions when the solutions were not stirred. The accumulation of large amounts of the gaseous product existing in a highly supersaturated state in the solution might tend to make a reaction reversible.

Mr. LAMPLOUGH in reply stated that the method adopted for the preparation of the diazobenzene chloride was that described by Dr. Cain in his paper. The solution was raised to the desired temperature in 15—30 seconds.

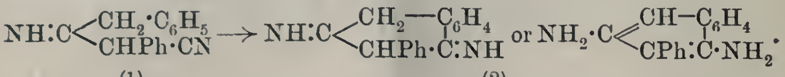
As evidence that supersaturation was really present the author referred to an actual comparison experiment, showing the volume of gas evolved from solutions stirred and not stirred, where it was seen from the lantern slide exhibited that at one time 37 c.c. of the solution at 62° held supersaturated 22 c.c. of nitrogen, or more than thirty times the amount calculated from the solubility of the gas. The author also gave numbers showing the great difference between his constants for the reaction and those determined by Cain and Nicoll.

A reaction resulting in the evolution of carbon dioxide had been studied, but owing to the greater solubility, the degree of supersaturation was small, and at present the author had not sufficient data to say whether a highly supersaturated solution is more easily formed in the case of the more insoluble gases.

In the comparison experiments on the decomposition of hydrogen peroxide in which the rates of reaction were determined by measurement of the gas evolved from the stirred solution and by titration respectively, in the latter case the solution was *not* stirred, and therefore the close agreement in the results showed that the rate of evolution of gas from the stirred solution also measured truly the rate of reaction in the still liquid. Moreover, if the reaction is allowed to begin without agitation and at a given time the solution is suddenly stirred, an immediate evolution of gas takes place, making the total volume of gas evolved equal to the amount given off in the same time *with* stirring, thus showing that stirring does not influence the rate of the reaction, but simply gives a correct method of measuring it.

*204. "The formation and reactions of imino-compounds. Part II. Condensation of benzyl cyanide leading to the formation of 1:3-diaminonaphthalene and its derivatives." By Ernest Francis Joseph Atkinson and Jocelyn Field Thorpe.

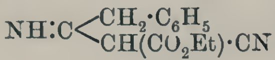
Benzyl cyanide condenses with its sodium derivative to form β-imino-α-cyano-$\alpha\gamma$-diphenylpropane (1), which on treatment with sulphuric acid is completely converted into 1 : 3-*diamino-2-phenylnaphthalene* (2).



$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CH_2{\cdot}C_6H_5}\\ \mathrm{CHPh{\cdot}CN}\end{matrix}\longrightarrow\mathrm{NH{:}C}<\begin{matrix}\mathrm{CH_2—C_6H_4}\\ \mathrm{CHPh{\cdot}C{:}NH}\end{matrix}\text{ or }\mathrm{NH_2{\cdot}C}\ll\begin{matrix}\mathrm{CH—C_6H_4}\\ \mathrm{CPh{:}C{\cdot}NH_2}\end{matrix}.$$

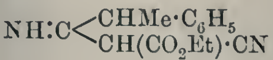
(1) (2)

Benzyl cyanide also combines with the sodium derivative of ethyl cyanoacetate, forming ethyl β-imino-α-cyano-γ-phenylbutyrate (3), from which on treatment with sodium ethoxide and either methyl or ethyl iodide, *ethyl β-imino-α-cyano-γγ-phenylmethylbutyrate* (4), or *ethyl β-imino-α-cyano-γγ-phenylethylbutyrate* (5) can be prepared. From these compounds on treatment with sulphuric acid ethyl 1 : 3-diaminonaphthalene-2-carboxylate (6), *ethyl* 1 : 3-*diamino-4-methylnaphthalene-2-carboxylate* (7), and *ethyl* 1 : 3-*diamino-4-ethylnaphthalene-2-carboxylate* (8) are formed respectively :



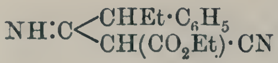
$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CH_2{\cdot}C_6H_5}\\ \mathrm{CH(CO_2Et){\cdot}CN}\end{matrix}$$

(3)



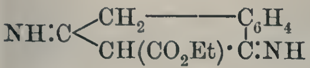
$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CHMe{\cdot}C_6H_5}\\ \mathrm{CH(CO_2Et){\cdot}CN}\end{matrix}$$

(4)



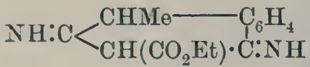
$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CHEt{\cdot}C_6H_5}\\ \mathrm{CH(CO_2Et){\cdot}CN}\end{matrix}$$

(5)



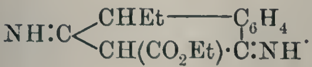
$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CH_2——C_6H_4}\\ \mathrm{CH(CO_2Et){\cdot}C{:}NH}\end{matrix}$$

(6)



$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CHMe——C_6H_4}\\ \mathrm{CH(CO_2Et){\cdot}C{:}NH}\end{matrix}$$

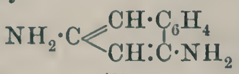
(7)



$$\mathrm{NH{:}C}<\begin{matrix}\mathrm{CHEt——C_6H_4}\\ \mathrm{CH(CO_2Et){\cdot}C{:}NH}\end{matrix}.$$

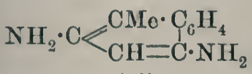
(8)

The ethyl esters (6), (7), and (8) are converted on hydrolysis into the corresponding *carboxylic acids*, which on heating above their melting points are transformed into 1 : 3-diaminonaphthalene (9), 1 : 3-*diamino-4-methylnaphthalene* (10), and 1 : 3-*diamino-4-ethylnaphthalene* (11), respectively :



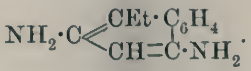
$$\mathrm{NH_2{\cdot}C}\ll\begin{matrix}\mathrm{CH{\cdot}C_6H_4}\\ \mathrm{CH{:}C{\cdot}NH_2}\end{matrix}$$

(9)



$$\mathrm{NH_2{\cdot}C}\ll\begin{matrix}\mathrm{CMe{\cdot}C_6H_4}\\ \mathrm{CH{=}C{\cdot}NH_2}\end{matrix}$$

(10)



$$\mathrm{NH_2{\cdot}C}\ll\begin{matrix}\mathrm{CEt{\cdot}C_6H_4}\\ \mathrm{CH{=}C{\cdot}NH_2}\end{matrix}.$$

(11)

DISCUSSION.

The PRESIDENT pointed out that the very elegant synthetical method of obtaining 1 : 3-diaminonaphthalene made known by the authors might prove of great practical use in preparing this base in quantity. The method hitherto available, in which dinitro-α-acetnaphthalide is the starting point, is both circuitous and costly.

In reply to a question from Mr. Lees, Dr. THORPE said that only primary nitriles reacted to form the imino-compounds; one of the two nitriles entering into the reaction must contain the group $CH_2 \cdot CN$.

*205. "Note on the anhydride of phenylsuccinic acid." By Francis Bernhard Dehn and Jocelyn Field Thorpe.

The authors have investigated the anhydride of phenylsuccinic acid and conclude that it exists in only one form, which melts at 53—54°. They have been unable to prepare the other form of the anhydride melting at 150° described by Bredt and Kallen and by Wegscheider and Hecht, but by following the experimental details given by these investigators they have isolated an impure form of the acid which melts at this temperature. The authors have been unable to confirm the observation of Wegscheider and Hecht that the anhydride melting at 53—54° gradually passes into that melting at 150° when kept at the ordinary temperature and also at 100°. They have kept specimens of the pure anhydride for several months under these conditions and have observed no change.

*206. "Influence of sodium arsenate on the fermentation of glucose by yeast-juice." (Preliminary notice.) By Arthur Harden and William John Young.

It has been previously shown that when a soluble phosphate is added to yeast-juice containing glucose, the rate of fermentation is greatly increased (5 to 10 times), and proceeds at a gradually diminishing rate until an extra amount of carbon dioxide (equivalent, molecule for molecule, to the phosphate added) has been evolved. The rate then becomes equal to, or somewhat greater than, that of the original juice to which no addition has been made. The phosphate at the same time undergoes a change which renders it non-precipitable by magnesia mixture (*Proc. Roy. Soc.*, 1906, **77**, *B*, 405).

When an equivalent amount of arsenate is substituted for the phosphate a similar acceleration is produced, but the phenomena are somewhat different. The rate is greatly increased (8 to 12 times), but this high rate continues for a considerable time without change, until many times the equivalent of carbon dioxide has been evolved, and then falls gradually, the fermentation ceasing considerably before that of a sample of the same yeast-juice to which no addition of arsenate has been made.

An example is afforded by an experiment with the undermentioned solutions:

(1) 20 c.c. of yeast-juice + 5 c.c. water + 5 grams glucose.

(2) 20 c.c. of yeast-juice + 5 c.c. $3M/10$ di-sodium hydrogen arsenate + 5 grams glucose.

The following numbers give the number of c.cs. of carbon dioxide evolved during the time given in the first column:

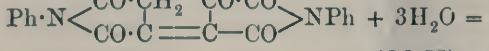
	c.cs. of CO_2	
Time.	Sol. 1.	Sol. 2.
1 hour	20·9	249·8
2 hours	41·2	491·5
5 ,,	99·5	797
6 ,,	118·1	831
7 ,,	136·2	848·8

At the end of seven hours, the rate per hour of solution 1 was still 18 c.cs. per hour, and that of solution 2 had fallen from 249·8 to 14·8.

The rate attained and the duration of the fermentation vary both with the particular specimen of yeast-juice and with the amount of arsenate added, there being a certain optimum amount of arsenate for each sample of yeast-juice. The added arsenate remains precipitable by magnesia mixture after an equivalent of carbon dioxide has been evolved, and is also still in the same form when the fermentation ceases, so that in this respect it differs from the phosphate.

207. "Xanthoxalanil and its analogues." By Siegfried Ruhemann.

When xanthoxalanil is acted on by caustic potash, it yields oxalic acid and *dianilaconitic acids* (m. p. 199—200°):



$$Ph\cdot N\!<\!\begin{matrix}CO\cdot CH_2 & CO\cdot CO \\ CO\cdot C = & C - CO\end{matrix}\!>\!NPh + 3H_2O =$$

$$(CO_2H)_2 + C_3H_3(CO_2H)(CO\cdot NHPh)_2;$$

the latter of which differs from the compound described by Michael (*Amer. Chem. J.*, 1887, 9, 193) and, on hydrolysis with hydrochloric acid, furnishes aconitic acid. *Xanthoxalo*-m-*xylidil*, $C_{24}H_{20}O_5N_2$, similarly gives *di*-m-*xylidil aconitic acid*, melting at 196—197° with decomposition. Xanthoxalanil and its analogues are transformed into colourless substances on reduction with zinc dust and acetic acid. The *compound* (m. p. 160—161°) which is thus formed from xanthoxalo-*m*-xylidil, has the formula $C_{24}H_{26}O_5N_2$.

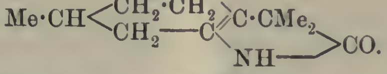
208. "Derivatives of cyanodihydrocarvone and cyanocarvomenthone." By Arthur Lapworth.

Cyanodihydrocarvone (*Trans.*, 1906, **89**, 949) yields a *cyanohydrin* which is slowly hydrolysed by mineral acids, being finally transformed into 2-*methyl*-5-iso*propenyl*-Δ^2-*tetrahydro*iso*phthalic acid*. On reduction, the latter yields a mixture of isomeric 2-*methyl*-5-iso*propenylhexahydro*iso*phthalic acids*, which, although still unsaturated, are not further reduced by sodium amalgam.

The addition compounds of cyanodihydrocarvone with hydrogen halides are well characterised substances which yield substitution products with bromine. The *hydriodide* may be reduced by zinc and methyl alcohol to *cyanocarvomenthone*, which may be converted by acids into *carvomenthonecarboxylic acid* and by alkalis into carvotanacetone.

209. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part VI. The action of potassium cyanide on pulegone." By Reginald William Lane Clarke and Arthur Lapworth.

The compound $C_{11}H_{17}ON$, obtained by the action of potassium cyanide on pulegone, is easily converted into *menthonecarboxylic acid* (compare Hann and Lapworth, *Proc.*, 1904, **20**, 54). The latter may be transformed into an unsaturated *lactone*, $C_{11}H_{16}O_2$, and from this, ammonia regenerates the initial substance $C_{11}H_{17}ON$, which is therefore not cyanomenthone, as was for a long time supposed, but the *anhydramide*,



$$\mathrm{Me{\cdot}CH}<\begin{array}{l}\mathrm{CH_2{\cdot}CH_2}>\mathrm{C{\cdot}CMe_2} \\ \mathrm{CH_2}\text{——}\mathrm{C} \\ \qquad\qquad\quad\mathrm{NH}\text{——}>\mathrm{CO.}\end{array}$$

This is obtained in all cases where the isomeric cyanomenthone would be the normal product.

210. "The influence of various substituents on the optical activity of tartramide." Part II. By Percy Faraday Frankland and Douglas Frank Twiss.

In continuation of the previous work of P. F. Frankland and Slator (*Trans.*, 1903, **83**, 1349), the authors have prepared and described the n- and iso*propylamides*, the *allylamide*, the n- and iso*butylamides*, and the n-*heptylamide* of tartaric acid. The rotation of these compounds has been determined in pyridine, in methyl alcohol, and, when possible, also in aqueous solutions.

All the aliphatic amides have much lower molecular rotations than the aromatic amides. In the fatty amides of the normal series, the molecular rotation increases without exhibiting a maximum up to the heptyl term, which is as far as the series has yet been explored. The rotation of the benzylamide and furfurylamide follows closely on that of the heptylamide, there being a large gap between these and the true aromatic amides.

Special interest attaches to the lower rotation found for the allylamide than for the normal propylamide, as in general the appearance of a double bond in a compound is attended with a marked increase in the rotation.

211. "The influence of various substituents on the optical activity of malamide." By Percy Faraday Frankland and Edward Done.

The authors described the preparation and properties of the *methylamide*, *ethylamide*, and iso*propylamide*, *allylamide*, and iso*butylamide*, n-*heptylamide*, *piperidide*, and *phenylhydrazide* of ordinary *l*-malic acid. The rotation was determined in pyridine, in methyl alcohol, and in glacial acetic acid solution.

The rotation is greatly influenced by the solvent. In pyridine solution, the amides of the normal series exhibit practically no change in molecular rotation from the methyl to the heptyl term. In methyl alcohol solution, on the other hand, there is a slight rise in the value of $[M]_D$ between the methyl and heptyl terms, whilst in glacial acetic acid solution there is a slight decline over the same interval.

The allylamide has a markedly lower rotation than the normal propylamide.

The piperidide and phenylhydrazide have much lower rotations than any of the aliphatic amides; in fact, even lower than that of malamide itself.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Electrochemical Society. Transactions. Vol. IX. Philadelphia 1906. (*Reference.*) From Dr. F. Mollwo Perkin.

Booraem, *John V. V.* Internal energy, a method proposed for the calculation of energy stored within matter. pp. 144. New York 1906. (*Recd.* 7/11/06.) From the Author.

Gordon Memorial College, Khartoum. Second report of the Wellcome Research Laboratories. pp. 255. ill. Khartoum 1906. (*Reference.*) From the Director.

Lewkowitsch, *Julius.* Technologie et analyse chimiques des huiles, graisses et cires. Traduit . . . par *Émile* **Bontoux.** Tome I. pp. xix + 561. ill. Paris 1906. (*Recd.* 5/11/06.) From the Author.

Wilson, *Frederick Robert Leyland,* and **Hedley,** *George Ward.* Elementary chemistry. 2 vols. pp. xii + 167, xix + 382. ill. Oxford 1905—1906. (*Recd.* 7/10/06.)

From the Delegates of the Clarendon Press.

II. *By Purchase.*

Biochemische Zeitschrift. Herausgegeben von *E.* **Buchner,** *P.* **Ehrlich,** *C. von* **Noorden,** *E.* **Salkowski,** *N.* **Zuntz.** Redigiert von *C.* **Neuberg.** Band I. Berlin 1906. (*Reference.*)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 10th December, 1906.

All persons who received grants in December, 1905, or in December of any previous year, and whose accounts have not been closed, are reminded that reports must reach the Hon. Secretaries not later than Saturday, 1st December next.

ERRATA.

P. 252, lines 1, 3, 18, 24, 26, 28, 30 from top, *for* "xanthydryl" *read* "xanthyl."

P. 269, line 6 from below, *for* "3" *read* "4."

P. 270, line 5 from top, *for* "3" *read* "4."

At the next Ordinary Meeting, on **Thursday,** December **6th,** 1906, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The liquid volume of a dissolved substance." By J. S. Lumsden.

"Some derivatives of benzophenone. Synthesis of substances occurring in coco-bark." Preliminary notice. By W. H. Perkin, jun., and R. Robinson.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, 6th December, 1906.

Abegg, Richard,

Landbergstrasse 4, Breslau, Germany.

Doctor, Professor of Chemistry in the University of Breslau. Well known as a Scientific Investigator in the domain of Physical Chemistry.

William Ramsay. James Walker.
Arthur W. Crossley. *M. O. Forster.*
John S. Lumsden.

Arup, Paul Seidelin,

Marsden Villa, 62, Haverstock Hill, London, N.W.

Analytical Chemist. Associate of the City and Guilds Institute. M.A., King's College, Windsor, Nova Scotia. Published Paper in *Chem. Soc. Trans.*, in conjunction with Dr. E. F. Armstrong, 1904. Formerly Demonstrator at Goldsmiths' Institute; Chemist to Messrs. Cooper and Nephews, Berkhamsted, and Lecturer in Chemistry at King's College, Nova Scotia.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. William Robertson.
E. Frankland Armstrong. Robert J. Caldwell.

Bayliss, William Heath,

Brewery House, Ashwell, Herts.

Brewer and Maltster, and Brewer's Chemist. I was Chemist for nearly three years to Messrs. H. and G. Simonds, Ltd., Brewers, Reading.

H. Cecil Seabrooke.
F. G. Adair Roberts.
A. Boake.
Alfred C. Young.
W. T. Wright.

Bethea, Oscar Walter, Ph.G.,
Meridian, Miss.

Pharmacist and Pharmaceutical Chemist. Professor Pharmacology Miss. Medical College. Five years' work in chemical analysis and manufacturing, and several years preceding was engaged in general pharmaceutical chemical work.

George F. Payne.
Joseph P. Remington.
Henry A. Wetzel.
Virgil Coblentz.
Ch. F. Chandler.

Broome, James Spears,
18, Seedley Park Road, Pendleton, Manchester.

Science Lecturer under Salford Education Committee. B.Sc. with 1st Class Honours in Chemistry, Victoria University of Manchester.

Harold B. Dixon.
W. H. Perkin, jun.
G. H. Bailey.
J. F. Thorpe.
Norman Smith.
E. Green.

Byrom, Thomas Henry,
31, Wrightington Street, Wigan.

Analytical Chemist. Head Chemist to the Wigan Coal and Iron Co., Ltd. Lecturer on Theoretical and Applied Chemistry at the Wigan Technical College. Author of book, "The Physics and Chemistry of Mining."

J. E. Stead.
R. O. Burland.
James Smith.
Arthur H. Tuer.
G. Crewe Chambres.

Carmichael, John,
10, Cortayne Road, Fulham, S.W.

Analyst. Two years' study in Theoretical and Practical Chemistry at the Royal College of Science, London. Five years' analytical work in the Government Laboratory, London.

T. E. Thorpe.
H. W. Davis.
E. Grant Hooper.
C. Proctor.
Robert Rodger.

Carpenter, Percy Henry,

46, Streathbourne Road, Upper Tooting, S.W.

Analytical Chemist. Associate of Institute of Chemistry. Three years under Prof. Meldola at Technical College, Finsbury. Eight years as Chemical Assistant to Mr. A. C. Chapman. At present Chemist to the Cawnpore Sugar Co., Ltd.

Alf. C. Chapman.	Otto Hehner.
Fredk. T. Harry.	*W. P. Skertchly.*
F. G. S. Baker.	*M. O. Forster.*

Cockburn, Charles Taylor,

34, Queen's Gate, Dowanhill, Glasgow.

Managing Director, Cockburn & Co., Ltd., 130 to 140, Howard Street, Glasgow. Manufacturing Chemist. Member of Pharmaceutical Society. Director of the Laboratories. Desires to keep abreast of late developments in Chemistry—particularly in Physiological Chemistry.

Thomas Tyrer.	William Mair.
John C. Umney.	*Peter MacEwan.*
Thomas Morson.	*Thos. Farries.*

Cornwall, Reginald de Vere,

Salisbury, Rhodesia, South Africa.

Chemist to Medical and Public Health Department, Salisbury, Rhodesia. Pupil to Mr. Frederick Davis, B.Sc., and at Metallurgical Laboratories, King's College. Chemist to South African Saltpetre Fields, 1896–7. Present position since 1897.

W. F. Mawer.	Thos. Farries.
Leonard de Koningh.	Reginald G. Halstead.

T. Pitt.

Coward, Hubert Frank,

Hulme Hill, Plymouth Grove, Manchester.

Student. M.Sc. (Manchester). University Scholar. University Fellow in Chemistry, 1904. Assistant Lecturer in Chemistry, 1906.

Harold B. Dixon.	Norman Smith.
W. H. Perkin, jun.	D. L. Chapman.
Alfred Holt, jun.	J. F. Thorpe.

Crocker, Henry Ernest,

452, Slade Road, Gravelly Hill, Birmingham.

Analytical Chemist. Three years' Technical Education at Swansea

Municipal Technical College. Chemist for 1 year at Standard Metals Co.'s Works, Runcorn. Chief Chemist for 2½ years at Jarrow-on-Tyne Cement Works. Chief Chemist for 3½ years to General Electric Co., Limited, Witton.

G. S. Turpin.
J. B. Coleman.
F. H. Lowe.
W. E. Oakden.
J. C. Crocker.

Davson, Archibald Prideaux,

39, Blandford Square, London, N.W.

Assistant to R. Bodmer, Esq., F.C.S. Associate (in Chemistry) of the Royal College of Science, London. For two years assistant to Mr. Bodmer.

William A. Tilden.
M. O. Forster.
Chapman Jones.
G. T. Morgan.
J. C. Philip.
R. Bodmer.

Dinwoodie, James Herbert,

Johannesburg.

Analytical Chemist and Pharmacist. President Transvaal Pharmacy Board.

Thomas A. Henry.
Peter MacEwan.
William Duncan.
Arthur W. Crossley.
Frederick B. Power.

Farmer, Charles George Edgar,

16, Herbert Crescent, London, S.W.

Undergraduate, New College, Oxford. Student.

T. C. Porter.
H. B. Baker.
S. Ruhemann.
Allan F. Walden.
N. V. Sidgwick.
Andrea Angel.

Field, Samuel,

53, Whitburn Road, Lewisham, S.E.

Head of Department of Technical Chemistry, Northampton Institute, Clerkenwell, E.C. Assoc. Royal College of Science, 1st class, Chemistry, 1898. Late Teaching Scholar, R.C.S., London, 1898—1900. Late Lecturer in Chemistry, Central Polytechnic, Croydon.

R. Mullineux Walmsley.
Thomas Turner.
A. H. Mundey.
W. E. Harrison.
M. O. Forster.
J. B. Farlie.
Chas. R. Darling.
H. Russell Pitt.

Fitzgerald, Anthony Nisbet,

12, St. Mary's Road, Strood, Rochester.

Science Teacher. B.A., B.Sc. (London University), Chemistry, at final B.Sc., 1903. Teacher of Chemistry since 1900 in the Mathematical School, Rochester. Lecturer in Metallurgy, Gillingham Technical Institute, 1904–5. Lecturer in Chemistry. Chatham Technical Institute, since 1904. Formerly Student of Chemistry in Heriot-Watt College, Edinburgh, and in Battersea Polytechnic Institute.

Peter MacEwan. J. L. White.
John Wilson. *H. Wilson.*
John C. Umney.

Grubb, David Paton,

Windsor Hill, Newry.

Head Science Master, Municipal Technical School, Newry. B.Sc. (Edinburgh) in Engineering. B.Sc. (Edinburgh) in Pure Science (Chemistry in final). A.R.S.M. (London) in Metallurgy (1st Class). Science Master, Municipal Technical School, Newry.

Alex. Crum Brown. Frank W. Young.
Leonard Dobbin. W. Gowland.
W. H. Merrett.

Hall, Octavius,

6, Devonshire Villas, Plymouth.

Medical Officer of Health for the County Borough of Devonport, &c. As student, attended Course Theoretical Chemistry, University of Durham; of Practical Chemistry, King's College, London; of Analytical Chemistry as applied to Public Health requirements, University College, Bristol, and Royal College of Surgeons, Dublin. Medical Qualifications: D.P.H., L.R.C.P., L R.C.S., L.F.P.S.G. In connection with Analytical Chemistry, am actively interested in details of Analytical Chemistry of Food, Drugs, &c., in discharge of routine duties as M.O.H. for the County Borough of Devonport, and wish to keep in touch with modern methods.

Robt. A. Bolam. Francis Francis.
Sydney Young. *W. Crabb.*
H. Lucas.

Hamer, John,

44, Sugden Road, Clapham Common, London, S.W.

Analytical Chemist and Brewer. First Class Brewer's Ordinary City and Guilds. First Class Brewer's Honours City and Guilds.

Chemist to Gillman and Spencer's (1902), Ltd., Castle Brewery Works, Southwark, London, S.E.

J. Stewart Remington.
Claude Smith.
Jas. Grant.
F. G. Richards.
Walter Ratcliffe.
L. G. Radcliffe.
S. J. Peachey.
Thos. A. Young.

Hanson, H. Norman,
Field Head, Brighouse.

Analytical Chemist. Three years articled pupil and one year assistant with F. W. Richardson, Esq., F.I.C., &c., and West Riding of Yorks. County Analyst, &c.; conjoint author of papers on "Chrome Estimation" (*Soc. Chem. Ind.*, May 30th, 1903) and "Valuation of Lubricants" (*S.C.I.*, April 15th, 1905); also member of the Society of Public Analysts.

F. W. Richardson.
A. Jaffé.
Lewis S. Cocking.
Walter M. Gardner.
B. North.
L. Gordon Paul.

Harris, Frederick James,
1, Alexandra Terrace, Bath Road, Exeter.

Associate of the City Guilds' Institute. Intermediate B.Sc., London, 1904. Engaged in Chemical Research at the Central Technical College, Exhibition Road, S.W.

Gerald T. Moody.
Henry E. Armstrong.
William A. Davis.
Edward Horton.
William Robertson.
Robert J. Caldwell.

Hines, Charles Percy,
The Grammar School, Dartford.

Assistant Master, The Grammar School, Dartford. B.Sc. (London University). Senior Science Master, Dartford, from September 1902 to present time. Junior Science Master, Bakewell Grammar School, and School of Science, 1900—1902. Studied at (i) Wellingboro' Grammar School (six years); (ii) King's College, London; Advanced Chemistry at (iii) Goldsmiths' Institute, New Cross (under Dr. Lapworth).

A. E. Barker.
S. G. Eade.
J. H. Howgate.
C. Jodrell Mansford.
William Briggs.

Johnston, Archibald McArthur,

Germiston, Transvaal, Box 108.

Metallurgical Chemist. Studied Chemistry in Glasgow and W. of Scot. Tech. Inst. Chief Assistant to Dr. J. Loevy, Gov. Analyt. Chemist, Johannesburg, 1895—1899. Head Analytical Chemist, General Mining and Fin. Corp., Johbg., 1902—1904. Chief Metall. Chem., Consol. Gold Fields, Johannesburg. Contribution and discussion before Chem. Met. and Mining Socy., Johannesburg.

W. A. Caldecott.
J. A. Wilkinson.
Walter C. C. Pakes.
A. L. Landau.
James Moir.

Jones, Edward Rees,

Llangedwyn Vicarage, Oswestry.

Science Master at Deacon's School, Peterboro'. Inter. B.Sc., London University. Studied Chemistry under Dr. Sudborough at Univ. College, Aberystwyth. Have been teaching Chemistry for the last seven years.

L. Hansen Bay.
Wm. Barbour.
J. J. Sudborough.
Wm. T. Thomson.
W. Rintoul.
G. H. Welsford.

Ladell, William Richard Simpson,

19, Alwyne Road, London, N.

Analytical Chemist. Obtained the certificate of the Chemical Dept. of the Finsbury Technical College (Sessions 1903–06). Passed Intermediate A.I.C. examination.

R. Meldola.
John Castell-Evans.
John Spiller.
Edward Bevan.
C. F. Cross.

McIntosh, David,

Stamford School.

Science Master at above school. As Student: Four years' full laboratory training and lectures at Armstrong College, Newcastle-on-Tyne (B.Sc. with chemistry, 1902). As Teacher: Five years' daily teaching of Chemistry in secondary schools.

P. Phillips Bedson.
F. C. Garrett.
S. Hoare Collins.
James Leicester.
H. Dean.
J. T. Dunn.

Mastin, John, F.R.M.S., &c.,

Woodleigh House, Totley Brook, near Sheffield.

Chemical Investigation and Analysis. Author of a number of articles on chemical subjects, *e.g.*, The Composition of Steel (Metallurgical), &c. Sole patentee of two inventions for printing by chemical deposits. Sole patentee of an invention for recovery of ammonia from waste products. Sole patentee of an invention for imitation ivory from waste chemicals. Sole patentee of two inventions for chemical dyes. Sole patentee of two inventions for chemical pigments for paint. Joint patentee of four inventions for chemical pigments.

G. T. W. Newsholme.
Chas. Bradshaw.
G. E. Scott-Smith.
J. E. Alger Blyde.
W. T. Wright.
Fredk. J. Merrils.

Middleton, Alexander Edmund,
112, South Park Road, Wimbledon, S.W.

Analyst, Government Laboratory. Royal College of Science. Student in analytical chemistry, 2 years. Government Laboratory, 10 years.

T. E. Thorpe.
William A. Tilden.
G. T. Morgan.
M. O. Forster.
Chapman Jones.

Morris, Arthur Higgs.
77, Beverly Road, Bolton, Lancashire.

Brewer. Has been a student of chemistry at the Royal College of Science and University College, London.

Horace T. Brown.
William A. Tilden.
G. T. Morgan.
M. O. Forster.
James C. Philip.

Naylor, George,
45, Hornby Rd., Blackpool.

Pharmaceutical Chemist. Passed Major Examination of the Pharmaceutical Soc. Passed Minor Examination of the Pharmaceutical Soc. Late Chemistry Demonstrator School of the Pharmaceutical Soc. Engaged in business as a Pharmaceutical Chemist.

Arthur W. Crossley.
W. Palmer Wynne.
T. E. Wallis.
E. Towyn Jones.
M. O. Forster.

Newton, Arthur Percival, B.Sc. (Lond.),
Red Cot, Coulsdon, Surrey.

Lecturer in Chemistry, Morley College, London. Science Master, Strand School, King's Coll., London.

John Wilson.
J. S. White.
G. Nevill Huntly.
E. F. Harrison.
J. Hart-Smith.

Oxland, Charles Harold,

37, Waterloo Rd., Bedford.

Science Master at Wellingborough Grammar School. For four years a student in the Owens College laboratories. Bachelor of Science with Honours in Chemistry, Manchester University (1904). Appointed Science Master at the Wellingborough Grammar School in September, 1905.

H. B. Dixon. Norman Smith.
W. H. Perkin, jun. D. L. Chapman.
Alfred Holt, jun. J. F. Thorpe.

Porritt, Benjamin Dawson,

Holly Lodge, 33, South Park Hill, South Croydon.

Third year Chemical Student at University College, London.

William Ramsay. J. Norman Collie.
Samuel Smiles. N. T. M. Wilsmore.
A. W. Stewart.

Redgrove, Herbert Stanley,

137—140, Tottenham Court Road, W.

Student. Student of Chemistry; passed Inter. B.Sc. (London) with Hons. in Chemistry; Studying for Final B.Sc. Hons. in Chemistry. Desirous of obtaining benefits of the Society:—Journal, Library, Meetings, etc.

W. H. Ratcliffe. H. R. Ellis.
A. Greeves. Frank E. Weston.
F. H. Lowe.

Richardson, Frederic Ion,

"Glenarbor," Kew, near Melbourne, Australia.

Analytical Chemist. B.A. (Camb.). As I am taking up chemistry in Australia the monthly Journal of the Chemical Society will help to keep me in touch with latest knowledge.

W. J. Sell. H. O. Jones.
F. E. E. Lamplough. *R. H. Adie.*
T. B. Wood.

Robinson, Reginald Ernest,

The Villas, Stoke-on-Trent.

Chemist. 1st Class, Part I., 2nd Class, Part II., Nat. Sci. Tripos, 1900, Cambridge. Engaged in manufacture of Coal Tar and Petroleum Products.

W. J. Sell. T. B. Wood.
H. J. H. Fenton. H. O. Jones.
F. E. E. Lamplough.

Sen, Gopal Chandra,
23, Bond Street, Leeds.

Dyeworks Chemist. M.A. in Chemistry, Calcutta University Assistant to Professor Rây for two years. Now going through a special course of Dyeing and Tinctorial Chemistry in the University of Leeds.

A. G. Green. A. G. Perkin.
Arthur Smithells. A. B. Steven.
J. B. Cohen.

Simonsen, John Lionel,
152, Barlow Moor Road, West Didsbury, Manchester.

Research Fellow in Chemistry in the Manchester University. B.Sc. (1st Class Honours Chemistry), 1904. M.Sc., 1906. Joint author with Prof. W. H. Perkin, jun., of "The Replacement of Hydroxyl by Bromine," *Trans.*, 1905.

Harold B. Dixon. G. H. Bailey.
W. H. Perkin, jun. Norman Smith.
D. L. Chapman.

Smith, Charles,
Knowsley Road, Smithills, Bolton.

Science Master, Bolton Municipal Secondary School. Seven years Teacher of Chemistry, Bolton Municipal Secondary School. For four years have had charge of Chemical Laboratories. Three years Lecturer in Chemistry at the Bolton Pupil Teachers' Centre. Now engaged teaching Chemistry, twenty-four hours per week.

Charles A. Fogg. E. Boardman.
T. M. Nightingale. F. Smith.
Walter Ratcliffe.

Starling, William R. R.,
23, Magdalen Road, Norwich.

Science Master, The Grammar School, Gillingham, Dorset. 1. Intermediate Practical Chemistry, University College, Nottingham. 2. Attended Chemistry Course at Norwich Technical Institute (1900—1901). 3. (1902—3—4). University Student at Nottingham

University College. Here obtained Higher Intermediate Mathematics and Intermediate Practical Physics. 4. London University Matriculation. In July, 1905, at Inter. B.Sc., London, was accepted in Physics (Honours), Chemistry, and Mathematics. Was refused in Mechanics. 5. Science Master since Christmas, 1905, at Gillingham Grammar School, Dorset.

Hugh Ramage. Arthur Slator.
Arthur W. Mason. Philip G. G. Moon.
S. Hewitt. *Dennis Tyrrell.*
L. Archbutt.

Telling, Harry George,
Cooksbridge, Sussex.

Brewer. Matric. London Univ. First Class Honours in Brewing, City and Guilds of London. Late Laboratory Assistant to Mr. Basil Wm. Valentin. Holding numerous advanced stage certificates Science and Art Dept.; late brewer and manager to the Carmarthen United Breweries. Owner Cooksbridge Brewery, Sussex.

Basil Wm. Valentin. Francis A. B. Jewson.
W. A. S. Calder. *Thomas Edwards.*
J. M. Collett.

Thorne, Emmanuel Isaac,
13, Cantwell Road, Plumstead, S.E.

Metallurgist. Metallurgist in the Cartridge Factories, Royal Arsenal, Woolwich. Member of the Faraday Society. Honours certificates in Iron and Steel Manufacture and Chemistry; 1st Class certificates in Metallurgy, Stages II and III, and Queen's Prize, B. of E.

J. C. Aylan. H. Heron Smith.
Charles A. Keane. Godfrey Melland.
H. Burrows. W. R. Hodgkinson.
Wesley Lambert. *F. Mollwo Perkin.*
H. D. Law.

Watt, George Gordon,
26, Albert Square, Clapham Road, S.W.

Lecturer on, and Demonstrator of, Chemistry. Pharmaceutical Chemist. Member of the Pharmaceutical Society. Now, and for the past three years, Lecturer on, and Demonstrator of, Chemistry at the London College of Pharmacy.

Arthur L. W. Fechtner. Frank E. Weston.
R. Mullineux Walmsley. *Peter MacEwan.*
F. Filmer de Morgan.

Watson, Frederick William, B.Sc. (Lond.), F.I.C.,
Germiston, Transvaal, South Africa. P.O. Box, 108.

Analytical Chemist. Four years a student in the Chemical Department of the Glasgow and West of Scotland Technical College; 1 year research in the same institution under Professor G. G. Henderson. Five years' experience in Technical Chemistry. At present chief assistant to the Metallurgical Chemist of the Consolidated Goldfields of South Africa, Ltd. Wish to keep in touch with current chemical work.

W. A. Caldecott. G. G. Henderson.
A. L. Landau. Thomas Gray.
Alexander Davidson, jun.

Winther, Chr., Mag. Scient.,
Copenhagen,

Lecturer in Chemistry in the University of Copenhagen. Since 1895 I have published (mostly in the *Zeitschr. f. physikalische Chemie*) scientific work, especially on optical activity. As a lecturer in practical chemistry (since 1900) I have written a text-book of analytical chemistry, which is now used at the University of Copenhagen.

W. H. Perkin. Arthur Harden.
W. H. Perkin, jun. *Arthur Lapworth.*
Alex. McKenzie. *M. O. Forster.*

The following certificate has been authorised by the Council for presentation to ballot under Bye-Law I (3):

Tarak Nath Majumdar, L.M.S.
37, Lower Chitpore Road, Calcutta, India.

Medical Inspector of Food-stuffs, Corporation of Calcutta. Student of Chemistry, Presidency College, Calcutta, 1894—1896. Student of Chemistry, Medical College, Calcutta, 1896—1898. Passed the F.A. Examination and the Preliminary Scientific M.B. Examination (in Chemistry) of the Calcutta University in 1896 and 1898. I was engaged in the Analysis of Food-stuffs for one and half years.

J. Sen. *P. C. Rây.*
A. Ghose. *A. L. Sircar.*
Satya-prasad Sarbadhicary.

R. CLAY AND SONS, LIMITED, BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 15/12/06

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 317.

Thursday, December 6th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

George Bagley, Wellington, New Zealand.
Frank Baker, B.Sc., St. John's School, Eton.
Taylor Cook, B.Sc., 20, Sheddridge Street, Parson's Green, S.W.
Colin Ernest Dall, B.Sc., Maisonette, Maybury Road, Woking.
Frederick Alldis Eastaugh, Forty Hill, Enfield.
Edward William Lanchester Foxell, B.Sc., 22, Grand Avenue, Muswell Hill, N.
William Howieson Gibson, B.Sc., 109, Brecknock Road, Holloway, N.
Christopher Maurice Walter Grieb, B.Sc., 33, Torrington Park, Finchley, N.
William Marrs Hooton, M.A., M.Sc., Repton, Burton-on-Trent.
Arthur Vivian Hussey, Banthwaite, Belmont, Sutton, Surrey.
Ernest Wilfrid Jackson, 65, Douglas Terrace, Middlesbro'.
Albert Theodore King, B.Sc., Church Hill, Horsell, Woking.
Joseph Martin, B.Sc., Coopers' Company's School, Bow, E.
Otto Oberländer, Ph.D., Chamber of Commerce Buildings, Oxford Court, E.C.
Frederic George Percy Remfry, B.A., D.Sc., Sunnymead, Tenby.
Richard Noel Garrod Thomas, B.A., Balliol College, Oxford.
Robert Burt Wight, M.A., 3, Clarendon Terrace, Linthorpe Road, Middlesbro'.
Mark Arthur Wolff, 6, Hanover Terrace, Holland Park, W.

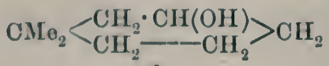
A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Richard Abegg, Ph.D.
Paul Seidelin Arup, M.A.
William Heath Bayliss.
Oscar Walter Bethea.
James Spears Broome, B.Sc.
Thomas Henry Byrom.
John Carmichael.
Percy Henry Carpenter.
Charles Taylor Cockburn.
Reginald de Vere Cornwall.
Hubert Frank Coward, M.Sc.
Henry Ernest Crocker.
Archibald Prideaux Davson.
James Herbert Dinwoodie.
Charles George Edgar Farmer.
Samuel Field.
Anthony Nisbet Fitzgerald, B.A., B.Sc.
David Paton Grubb, B.Sc.
Octavius Hall, L.R.C.P., L.R.C.S.
John Hamer.
H. Norman Hanson.
Frederick James Harris.
Charles Percy Hines, B.Sc.
Archibald McArthur Johnston.
Edward Rees Jones.
William Richard Simpson Ladell.
David McIntosh, B.Sc.
Tarak Nath Majumdar.
John Mastin.
Alexander Edmund Middleton.
Arthur Higgs Morris.
George Naylor.
Arthur Percival Newton, B.Sc.
Charles Harold Oxland, B.Sc.
Benjamin Dawson Porritt.
Herbert Stanley Redgrove.
Frederic Ion Richardson, B.A.
Reginald Ernest Robinson, B.A.
Gopal Chandra Sen, M.A.
John Lionel Simonsen M.Sc.
Charles Smith.
William R. R. Starling.
Harry George Telling.
Emmanuel Isaac Thorne.
George Gordon Watt.
Frederick William Watson, B.Sc.
Chr. Winther, Mag. Scient.

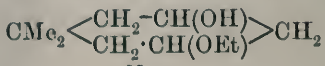
Of the following papers, those marked * were read:

*212. "Action of reducing agents on 5-chloro-3-keto-1:1-dimethyl-Δ^4-tetrahydrobenzene." By Arthur William Crossley and Nora Renouf.

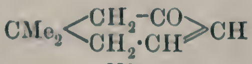
Experiments have proved that chloroketodimethyltetrahydrobenzene behaves in a varied manner towards reducing agents. Thus, sodium in moist ethereal solution (*Trans.*, 1905, 87, 1494) gives, as main product, 3-hydroxy-1:1-dimethylhexahydrobenzene (I), whereas sodium in absolute alcoholic solution yields a small amount of this alcohol, and to a much larger extent *3-hydroxy-5-*


$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2\cdot CH(OH)}\\ \mathrm{CH_2 — CH_2}\end{matrix}>\mathrm{CH_2}$

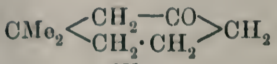
I.


$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2{-}CH(OH)}\\ \mathrm{CH_2\cdot CH(OEt)}\end{matrix}>\mathrm{CH_2}$

II.


$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2{-}CO}\\ \mathrm{CH_2\cdot CH}\end{matrix}\geqslant\mathrm{CH}$

III.


$\mathrm{CMe_2}<\begin{matrix}\mathrm{CH_2 — CO}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}>\mathrm{CH_2}$

IV.

ethoxy-1 : 1-*dimethylhexahydrobenzene* (II), as a colourless liquid boiling at 135°/25 mm.

When the chloroketone is treated with zinc filings in aqueous alcoholic solution, either in the cold or on heating, 3-*keto*-1 : 1-*dimethyl*-Δ^4-*tetrahydrobenzene* (III) is formed as a colourless liquid boiling at 88·5°/32 mm., and possessing an odour of almonds and camphor. On the other hand, zinc dust in either glacial or dilute acetic acid gives rise to 3-*keto*-1 : 1-*dimethylhexahydrobenzene* (IV), boiling at 77·5°/27 mm., and having a pungent camphoraceous odour.

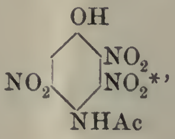
Characteristic derivatives of these various substances have been prepared, and in all cases their constitution has been conclusively proved by the oxidation products obtained from them.

In every reduction, dicyclic compounds are formed in addition to the simple ring compounds, and the following have been isolated and were described together with some of their derivatives.

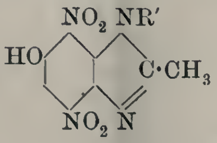
3 : 3′-*Diketo*-5 : 5 : 5′ : 5′-*tetramethyl*-$\Delta^{1:1'}$-*di*cyclo*hexene* (m. p. 178°); 1 : 1′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyl*-$\Delta^{2:2'}$-*di*cyclo*hexene* (m. p. 148°); 1 : 1′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyldi*cyclo*hexane* (m. p. 212°); 3 : 3′-*dihydroxy*-5 : 5 : 5′ : 5′-*tetramethyldi*cyclo*hexane* (m. p. 183°).

*213. "A new trinitroacetaminophenol and its use as a synthetical agent." By Raphael Meldola.

When diacetyl-*p*-aminophenol is nitrated by dissolving it in cold fuming nitric acid the first product is the mononitro-derivative, $C_6H_3(OAc)(NO_2)\cdot NHAc = 1 : 3 : 4$, corresponding to the *m*-nitro-*p*-aminophenol of Hähle (*J. pr. Chem.*, 1891, [ii], **43**, 63; Reverdin and Bucky, *Ber.*, 1906, **39**, 2687). This mononitrodiacetyl compound can be further nitrated by dissolving it in a mixture of fuming nitric and strong sulphuric acids, when a *trinitroacetaminophenol* is produced which forms the subject of the paper communicated by the author. This trinitro-derivative, which has not hitherto been described, is remarkably active as a synthetical agent owing to the extreme mobility of one of the nitro-groups. It crystallises in yellow needles melting with decomposition at 178—179°. The constitution is shown to be



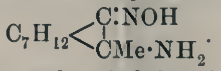
the nitro-group marked * being the mobile group. The action of various amines on the trinitro-compound has been studied and the final products shown to be substituted benziminazoles of the type



where R′ is the radicle present in the amine used. In some cases substituted diaryl- or alkylaryl-amines are formed as intermediate products, and these undergo "anhydridisation" on heating or on treatment with dehydrating agents. The trinitro-compound reacts also with hydrazines and with certain phenolic substances, the investigation of the products being still in hand.

*214. "Pinene nitrolamine." By Frederick Peacock Leach.

Pinene nitrosochloride, when allowed to remain at 45—50° with ammonia and alcohol, gives a well crystallised *nitrolamine*,



$$C_7H_{12}<\begin{array}{l}C{:}NOH\\ |\\ CMe{\cdot}NH_2\end{array}.$$

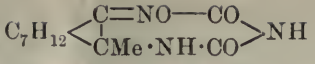
This compound melts somewhat indefinitely at 123—125°, contains approximately $\frac{1}{2}H_2O$, and crystallises from alcohol in long, silky needles.

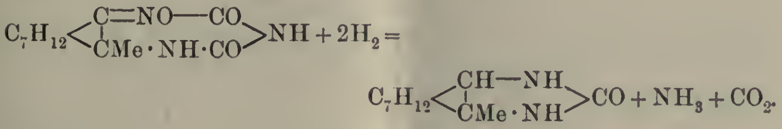
The *hydrochloride, oxalate,* and *platinichlorides* have been prepared: the *acetyl* derivative, $C_7H_{12}<\begin{array}{l}C{:}NOH\\ |\\ CMe{\cdot}NHAc\end{array}$, crystallises in hexagonal prisms melting at 224°; the *dibenzoyl* derivative melts at 167°, and the *diphenylcarbamide* at 133°.

Pinene nitrolamine reacts very readily with aldehydes, giving well crystallised condensation products; the *benzylidene* derivative, $C_7H_{12}<\begin{array}{l}C{:}NOH\\ |\\ C(CH_3)N{:}CHC_6H_5\end{array}$, melts at 162°; the *salicylidene* derivative at 128°, and the *furfurylidene* derivative at 164°.

With reducing agents either no action takes place or the amino-group is eliminated, giving rise to the ketone (Wallach's pinocamphone), which has been identified by means of its oxime melting at 86°.

*215. "A *pseudo*-semicarbazide from pinene." By Frederick Peacock Leach.

Potassium cyanate and pinene nitrosochloride interact in alcoholic solution, giving a *compound*, $C_{12}H_{17}O_3N_3$, the constitution of which is represented by the formula  $C_7H_{12}\left<\begin{array}{l}C{=}NO{-}CO\\ \vert\\ CMe\cdot NH\cdot CO\end{array}\right>NH$; it crystallises from alcohol in rosettes of prisms melting at 238—240°, dissolves in dilute alkalis, and gives alkali salts. When reduced with zinc dust and dilute acetic acid, a pseudo-*carbamide* is obtained which melts at 224°:



$$C_7H_{12}\left<\begin{array}{l}C{=}NO{-}CO\\ \vert\\ CMe\cdot NH\cdot CO\end{array}\right>NH + 2H_2 = C_7H_{12}\left<\begin{array}{l}CH{-}NH\\ \vert\\ CMe\cdot NH\end{array}\right>CO + NH_3 + CO_2.$$

Concentrated sulphuric acid gives pinene nitrolamine, carbon dioxide, and ammonia. The action of nitrous acid converts the *pseudo*-carbamide into a *nitroso*-compound, which crystallises from alcohol in yellow plates with a pink lustre and melting at 161°; this on reduction gives a pseudo-*semicarbazide* melting at 209°, from which by the action of aldehydes and ketones several of the ψ-semicarbazones have been prepared and analysed.

216. "Some derivatives of benzophenone. Synthesis of substances occurring in coto-bark. Preliminary notice." By William Henry Perkin, jun, and Robert Robinson.

A mixture of veratryl chloride and pyrogallol trimethyl ether suspended in carbon disulphide reacts readily with aluminium chloride with the formation of 1 : 2 : 3 : 3′ : 4′-*pentamethoxybenzophenone*, $(MeO)_2C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$, which crystallises from alcohol in prisms and melts at 125°. If, however, the reaction is prolonged, the product contains *hydroxytetramethoxybenzophenone*, which crystallises in needles, melts at 115° and is readily separated from the pentamethoxy-derivative on account of its solubility in alkalis.

When hydroxytetramethoxybenzophenone is treated with benzoyl chloride and caustic potash it yields a *benzoyl* derivative which crystallises from alcohol in stout, colourless prisms, melts at 149° and is converted into pentamethoxybenzophenone when it is treated with methyl sulphate and caustic potash.

2 : 4 : 6 : 3′ : 4′-*Pentamethoxybenzophenone* (pentamethylmaclurin), $(MeO)_2C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$, is obtained when aluminium chloride reacts with a mixture of veratryl chloride and phloroglucinol trimethyl ether in the presence of carbon disulphide. It melts at 156—157° and yields a *monobromo*-derivative (m. p. 144°) when its solution in chloroform is treated with bromine, and there can be no doubt that it is identical with the substance which Ciamician and Silber (*Ber.*, 1892,

25, 1132) obtained from protocotoin, $CH_2{:}O_2{:}C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$, by substituting two methyl groups for the methylene group.

Since 2 : 4 : 6 : 3′ : 4′-pentamethoxybenzophenone is pentamethylmaclurin, many attempts were made with the object of converting it into maclurin itself, but so far without success.

3′ : 4′-*Methylenedioxy*-2 : 4 : 6-*trimethoxybenzophenone*,

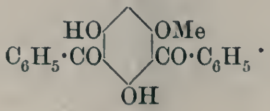
$$CH_2{:}O_2{:}C_6H_3\cdot CO\cdot C_6H_2(OMe)_3,$$

was next synthesised by treating a mixture of piperonyl chloride and phloroglucinol trimethyl ether in carbon disulphide solution with aluminium chloride. The substance so obtained melted at 133° and was identical with the oxyleucotin of coto-bark, as was shown by a careful comparison of the two preparations and by the fact that when they were mixed in equal quantities the melting point was the same as that of the constituents.

When phloroglucinol monomethyl ether, $C_6H_3(OMe)(OH)_2$, is treated with benzoyl chloride in the presence of zinc chloride, 2 : 4-*dibenzoxy*-6-*methoxy*-m-*phthalophenone*,

$$(C_6H_5\cdot CO)_2C_6H(OMe)(O\cdot CO\cdot C_6H_5)_2,$$

(m. p. 130—135°) is produced. This substance is readily hydrolysed by alcoholic potash with the formation of 2 : 4-*dihydroxy*-6-*methoxy*-m-*phthalophenone*, $(C_6H_5\cdot CO)_2C_6H(OMe)(OH)_2$, which melts at 187°, and is also produced when cotoin dibenzoate is treated with benzoyl chloride and zinc chloride. Its constitution must therefore be represented by the formula



217. "The liquid volume of a dissolved substance."

By John Scott Lumsden.

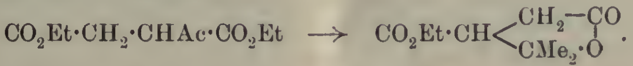
The values deduced for atomic volumes and atomic refractions from experiments made on pure liquids, hold with fair accuracy when applied to solids and liquids in solution; and the inference is that a liquid retains its own volume when dissolved, and that a solid assumes in solution the volume which the same weight of it would have if it existed as a liquid at the same temperature. If this inference is correct, a law of the "liquid volume" of a dissolved substance is made evident and experimental results are recorded which prove that there is such a law which holds, not only for the volume assumed by a solid and liquid, but also for the volume occupied by a dissolved gas.

The law is expressed as follows: When a substance in the liquid state dissolves without change of volume, the same substance when in the state of solid or gas will, when dissolved in the same solvent, change to the volume which the same weight of it would have if it were a pure liquid at the temperature of solution.

Irregularities are proved to be due to the experimentally ascertained facts that the volume in solution varies slightly with the solvent and with the degree of concentration of the solution and also from the circumstance that when a liquid is dissolved there is often a slight alteration in volume, but the deviation from accuracy from these causes is so small that the law deserves recognition as a guide when problems relating to solution in non-dissociating solvents are being dealt with.

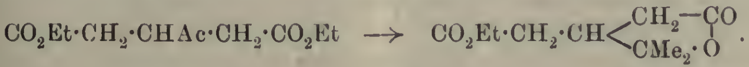
218. "A synthesis of terebic, terpenylic, and homoterpenylic acids." By John Lionel Simonsen.

When ethyl acetylsuccinate is treated with magnesium methyl iodide ethyl terebate is obtained,



$$CO_2Et{\cdot}CH_2{\cdot}CHAc{\cdot}CO_2Et \longrightarrow CO_2Et{\cdot}CH{<}\begin{array}{l}CH_2{-}CO\\ \quad\ \ |\\ CMe_2{\cdot}O\end{array}.$$

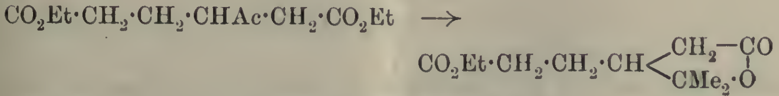
In a similar manner by the action of magnesium methyl iodide ethyl β-acetylglutarate is converted into ethyl terpenylate.



$$CO_2Et{\cdot}CH_2{\cdot}CHAc{\cdot}CH_2{\cdot}CO_2Et \longrightarrow CO_2Et{\cdot}CH_2{\cdot}CH{<}\begin{array}{l}CH_2{-}CO\\ \quad\ \ |\\ CMe_2{\cdot}O\end{array}.$$

When the sodium derivative of ethyl acetylsuccinate is treated with ethyl β-iodopropionate, ethyl β-acetylbutane-$\alpha\beta\delta$-tricarboxylate, $CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CAc(CO_2Et){\cdot}CH_2{\cdot}CO_2Et$, boiling at 200—201°/14 mm. is obtained.

This ester, when hydrolysed with concentrated hydrochloric acid, gives β-acetyladipic acid, $CO_2H{\cdot}CH_2{\cdot}CH_2{\cdot}CHAc{\cdot}CH_2{\cdot}CO_2H$, which melts at 102° and yields an ethyl ester boiling at 179°/18 mm. which, when treated with magnesium methyl iodide, is converted into homoterpenylic ester.



$$CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CHAc{\cdot}CH_2{\cdot}CO_2Et \longrightarrow CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CH{<}\begin{array}{l}CH_2{-}CO\\ \quad\ \ |\\ CMe_2{\cdot}O\end{array}$$

This, on hydrolysis, yields homoterpenylic acid (m. p. 100—101°), which is identical with the homoterpenylic acid obtained by Baeyer (*Ber.*, 1896, **29**, 1919) by the oxidation of pinene.

219. “Influence of light on diazo-reactions. Part I.” By Kennedy Joseph Previté Orton, Joseph Edward Coates (and, in part, Frances Burdett).

Solutions of diazonium salts in water, methyl or ethyl alcohol, acetic or formic acid, decompose rapidly on exposure to light, although in many cases they may be preserved for long periods if kept in the dark (compare *Proc.*, 1905, **21**, 168).

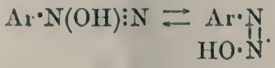
The product of the reaction depends on the solvent; in aqueous solution a phenol is formed; in methyl or ethyl alcohols, the corresponding phenyl, methyl, or ethyl ether is mainly produced, in some cases a certain amount of the diazonium salt being at the same time converted into hydrocarbon (replacement of the diazo-group by hydrogen); in acetic acid solution, a phenyl acetate is the sole product, but in formic acid, the change follows the equation: $\mathrm{Ar{\cdot}N(X){:}N + H{\cdot}CO_2H = ArH + N_2 + CO_2 + HX}$.

In most cases these reactions are quantitative; further, many diazo-compounds, which do not yield phenols, ethers, or phenyl acetates (for example, *s*-tribromodiazobenzene), when solutions in the appropriate solvents are heated, can be readily induced by light to undergo these changes.

Solutions of diazotates (*iso*diazotates) are not affected by light.

High concentrations of acid (for example 25 per cent. sulphuric acid) do not appreciably affect the rate of decomposition of the diazonium salts. Exposure to light of solutions of diazonium sulphates in 95 per cent. sulphuric acid brings about a conversion into the corresponding phenol.

These facts would appear to render untenable the view (Hantzsch) that phenols are formed from *syn*-diazohydroxides, since it is difficult to see how in such strongly acid solutions there can be any hydrolysis of the diazonium salt and consequent formation of the diazonium hydroxide to allow of their presence, thus:



$$\mathrm{Ar{\cdot}N(OH){:}N} \rightleftharpoons \begin{matrix}\mathrm{Ar{\cdot}N}\\ \|\\ \mathrm{HO{\cdot}N}\end{matrix}.$$

220. “The viscosity of liquid mixtures.” By Albert Ernest Dunstan and Robert William Wilson.

In continuation of previous work on this subject the authors have investigated the viscosity concentration curve of mixtures of water and sulphuric acid.

They find a well-defined maximum point corresponding with $\mathrm{H_2SO_4,H_2O}$, and a minimum corresponding with $\mathrm{3H_2SO_4,2H_2O}$.

The general behaviour of solutions from the point of view of viscosity was discussed and it was shown how, from a knowledge of the viscosity and the chemical series to which it belongs, it is possible to determine the molecular weight of a liquid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

British Association for the Advancement of Science. Report of the sixth meeting, 1836. London 1837. (*Reference.*)

From the Lawes Agricultural Trust.

Cross, *Charles Frederick,* and **Bevan,** *Edward John.* Researches on cellulose. II. (1900—1905.) pp. xi + 184. London 1906. (*Recd.* 26/11/06.)

From the Authors.

Koenigsberger, *Leo.* Hermann von Helmholtz. Translated by *Frances A.* **Welby.** With a preface by Lord Kelvin. pp. xviii + 440. ill. Oxford 1906. (*Recd.* 19/11/96.)

From the Delegates of the Clarendon Press.

II. *By Purchase.*

Blair, *Andrew Alexander.* The chemical analysis of iron. A complete account of all the best known methods for the analysis of iron, steel, pig-iron, iron ore, limestone, slag, clay, sand, coal, coke, and furnace and producer gases. 6th edition. pp. xix + 328. ill. Philadelphia 1906. (*Recd.* 20/11/06.)

III. *Pamphlets.*

Benedicks, *Carl.* Umwandlung des Feldspats in Sericit (Kaliglimmer). (From the *Bull. Geol. Inst. Upsala,* **7**, 1906.)

—— Yttriumhaltiger Mangangranat. (From the *Bull. Geol. Inst. Upsala,* **7**, 1906.)

—— Über das Gleichgewicht und die Erstarrungsstrukturen des Systems Eisen-Kohlenstoff. (From *Metallurgie,* **3**, 1906.)

Hersey, *Edmund.* A field experiment to test the merits of phosphate, potash, and nitrogen on a fine sandy loam of peculiar character. (From the *Bull. Bussey Inst.,* **3**, 1906.)

Reade, *T. Mellard*, and **Holland**, *Philip*. Sands and sediments. Part III. Final. (From the *Proc. Liverpool Geol. Soc.*, 1905—1906).

Roberts, *Edwin G. Ll.*, and **Wraight**, *Ernest A*. The preparation of carbon-free ferro-manganese. (From the *J. Iron and Steel Inst.*, 1906. II.)

ERRATUM.

PROCEEDINGS, 1906, No. 313, p. 206.

Line 7 from top, *for* "4" *read* "40."

At the next Ordinary Meeting, on **Thursday**, December **20th**, 1906, the following papers will be communicated:

"A new laboratory method for the preparation of hydrogen sulphide." By F. R. L. Wilson.

"The reaction of acids with methyl orange." By V. H. Veley.

"Contributions to the study of the calcium phosphates. I. The hydrates of the calcium hydrogen orthophosphates." By H. Bassett, jun.

"Contributions to the study of the calcium phosphates. II. The action of ammonia gas on the calcium hydrogen orthophosphates." By H. Bassett, jun.

"Relation between chemical constitution and physiological action in the tropeines." By H. A. D. Jowett and F. L. Pyman.

"Some derivatives of salicylic acid." By H. A. D. Jowett and F. L. Pyman.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 22. No. 318.

Thursday, December 20th, 1906, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

The PRESIDENT announced that the following congratulatory telegram had been sent this day to Prof. Adolph Lieben (Honorary and Foreign Member of the Society), on the occasion of his seventieth birthday and the fiftieth anniversary of his Doctorate.

"Hearty congratulations to our Honorary and Foreign Member, Dr. Adolph Lieben, from the Chemical Society, London.

"MELDOLA,
"*President.*"

Messrs. W. R. S. Ladell, W. T. Lattey, and J. Mastin were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Alfred Frederick Allen, B.Sc., 35, Purrett Road, Plumstead, S.E.
Henry Bassett, jun., B.Sc., Ph.D., 26, Belitha Villas, Barnsbury, N.
John Christie, B.A., Eton College, Windsor.
Francis Davidson, Dover Place, Ashford, Kent.
William Smith Denham, B.Sc., 2, Kelvinside Terrace North, Glasgow.
George Fowles, 28, Weltje Road, Hammersmith, W.
William Godden, B.Sc., Station Road (East), Canterbury.
Charles Pask Matthews, B.Sc., 6, Fortress Road, N.W.
Charles Schlienger, B.Sc., 273, Camden Road, N.
William George Sewell, B.Sc., 27, Park Road, Wandsworth Common, S.W.
Frederick George Shepheard, B.Sc., 9, Leinster Road, Rathmines, Co. Dublin.

Of the following papers, those marked * were read :

*221. "A new laboratory method for the preparation of hydrogen sulphide." By Frederick Robert Leyland Wilson.

The common method for the preparation of hydrogen sulphide by the interaction of hydrochloric acid and ferrous sulphide is open to several objections, the most serious of which is the liability of the gas to contain the hydrides of arsenic and phosphorus, due to the contamination of the iron sulphide with phosphide and arsenide. The method here described ensures freedom from these impurities, as well as the absence of most of the unpleasant accompaniments of the ordinary process of preparation.

If a current of hydrogen sulphide is passed over an alkali hydroxide, for example, sodium or calcium hydroxides, a hydrosulphide is formed, heat being evolved and a change in colour from white to yellow taking place. If a current of carbon dioxide is now passed over the hydrosulphide, the compound is at once decomposed, a carbonate being formed and hydrogen sulphide set free.

In the case of calcium hydroxide, the yellow substance has the composition $Ca(HS)(OH)$, and the action of carbon dioxide is given by the equation $Ca(HS)(OH) + CO_2 = CaCO_3 + H_2O + H_2S$.

A drying tower is filled either with granular soda-lime or an intimate mixture of calcium hydroxide and moist sawdust. A stream of hydrogen sulphide is passed into the tower until the contents are saturated with the gas, the course of the action being easily determined by the change in colour and by the movement of a heated zone upwards through the tower.

After the action has proceeded for some time the gas which escapes from the exit tube smells strongly of hydrogen phosphide and is inflammable, doubtless consisting of hydrogen mixed with all the other gaseous impurities evolved by the action of acid on the ferrous sulphide.

When the hydroxide has reacted with as much hydrogen sulphide as possible, a carbon dioxide generator is substituted for that supplying hydrogen sulphide, and the apparatus is ready to yield as slow or rapid a supply of the latter gas as may be desired.

The supply of hydrogen sulphide ceases at once when the stream of carbon dioxide is cut off, and if the exit tube from the tower is closed, a partial vacuum will soon be produced owing to combination of the gases in the tower with unaltered hydroxide.

Owing to this absorption of the gas in the tower, it is only necessary to cut off the supply of carbon dioxide in order to prevent further escape of hydrogen sulphide.

The rate of supply of the gas may be nicely regulated by introducing a short length of capillary glass tubing between the carbon dioxide apparatus and the generating tower.

The danger of contamination of the hydrogen sulphide with carbon dioxide is very small, and may be entirely eliminated by making use of two towers. As soon as the first shows signs of exhaustion (indicated when calcium hydroxide is used, by the change in colour) it is replaced by the second tower; a new one is put in place of the latter, and the supply of gas taken from this.

DISCUSSION.

The PRESIDENT asked how the method compared with the known laboratory process of preparing hydrogen sulphide by heating sulphur with certain hydrocarbons such as solid paraffin.

Mr. WILSON stated that he had not compared the two methods.

*222. "The affinity constants of aminocarboxylic and aminosulphonic acids as determined by the aid of methyl-orange." By Victor Herbert Veley.

The method of determining the affinity constants of acids by means of a very dilute methyl-orange solution and a tintometer described in a former paper (*Zeit. physikal. Chem.*, 1906, **57**, 147), as applied to the carboxylic acids and certain chloro- and hydroxy-derivatives, has been extended to the aminocarboxylic and aminosulphonic acids. It is shown that the same general mathematical expressions hold good, namely, those of straight lines $y = kx$ or $y = kx - b$, or logarithmic curves $\log y = \log k + x \log a$.

Acids which show irregularities in the Ostwald electric conductivity expression $\phi(k) = a^2/(1-a)V.(a = \mu/\mu_\infty)$ likewise show similar irregularities in the methyl-orange method.

The aliphatic aminocarboxylic acids act as neutral substances, but their hydrochlorides as hydrochloric acid only, hydrolysis being nearly complete at the degree of dilution used.

The special cases of asparaginic acid, as possessing a higher affinity factor than succinic acid, and of cacodylic acid, as allied to amphoteric electrolytes, have been investigated.

The aminobenzoic acids show a distinct acid function, and the results obtained are in a similar arithmetical ratio to those deduced by Winkelblech (at a different degree of dilution) by the electric conductivity method.

The two aminobenzenesulphonic acids studied, namely, sulphanilic (1 : 4) and metanilic (1 : 3) acids are remarkable in that the latter conforms to the straight line, but the former to the logarithmic expression.

The introduction of a second sulphonic grouping diminishes rather than increases the acid function.

A study of the naphthylamine mono- and di-sulphonic acids (eighteen in number) affords examples of steric "furtherance" as regards the positions 2 and 7 relative to 1, and of steric hindrance as regards the position 8 relative to all other positions.

DISCUSSION.

Dr. CAIN suggested that, as the 1-naphthylamine-8-sulphonic acid exhibited the phenomenon of "steric hindrance" and the 1-naphthylamine-2-sulphonic acid that of "steric furtherance," it would be of interest to know the behaviour of the 1-naphthylamine-4-sulphonic acid, particularly as this underwent molecular change into the 1 : 2-acid by the action of heat.

Dr. HEWITT asked if there was any definite stage between the colour of methyl-orange in alkaline and in acid solution. He had himself compared the absorptions of methyl-orange and butter-yellow, and found that the solutions of dimethylaminoazobenzene and sodium dimethylaminoazobenzenesulphonate on the one hand, and the salts of butter-yellow and acidified solutions of methyl-orange on the other gave practically identical absorption spectra. Any intermediate coloration between that of the free sulphonic acid and its sodium salt might be explained by partial neutralisation, and this opinion is confirmed by the fact that dimethylaminoazobenzenesulphonic acid in solution gives practically the same absorption as solutions of methyl-orange with an excess of mineral acid. The supposed free acid of methyl-orange would thus appear to be an internal salt.

The PRESIDENT asked whether special precautions had been taken to ensure the purity of the naphthylaminesulphonic acids used by the author, since the technical preparations supplied were professedly impure from the chemical point of view, and the difficulty of obtaining homogeneous products from mixtures of isomerides was often very great. With respect to the question of the proximity of position 8 as compared with position 2 relatively to position 1 in the naphthalene ring, he did not think that enough was known about the actual configuration of the atoms in the molecule to enable any dogmatic statement to be made.

Dr. VELEY, in reply, said that it would be unwise to express any dogmatic views as to the relative contiguity of substituent groupings in the naphthalene nucleus. As regards the position 4, a difficulty had arisen on account of the sparing solubility of the

1-naphthylamine-4-sulphonic acid. The acids had been purified previous to use by recrystallisation or otherwise. He felt some hesitation in discussing the actual composition of the yellow, orange-red, and red shades of methyl-orange, but it was clear that the last was the result of some more profound chemical change. In any case the hypothesis of migratory ions appeared to be too speculative.

*223. "Contributions to the study of the calcium phosphates. I. The hydrates of the calcium hydrogen orthophosphates." By Henry Bassett, jun.

Although numerous hydrates of dicalcium phosphate have been mentioned in the chemical literature, the author's experiments show that, in all probability, dicalcium phosphate can only form one hydrate, namely, the dihydrate.

The experiments also allow of some conclusions being drawn as to the position of certain of the quintuple points on the space model of the three-component system, $CaO—P_2O_5—H_2O$.

There are indications that the point at which the phases present are $CaHPO_4,2H_2O$; $CaHPO_4$; solid solution (see the papers by Cameron and Seidell in *J. Amer. Chem. Soc.*, 1905, 27, 1503, and Cameron and Bell, *J. Amer. Chem. Soc.*, 1905, 27, 1513); liquid solution and vapour lies at about 80°; whilst the point at which the phases $CaH_4(PO_4)_2,H_2O$; $CaHPO_4,2H_2O$; $CaHPO_4$; liquid solution and vapour can coexist lies at about 30°.

The monocalcium phosphate has also been studied, and it has been found possible to prepare the crystallised anhydrous salt. This compound can be obtained in long, bright prisms by crystallisation at 160° of a solution of calcium carbonate in orthophosphoric acid if the ratio of P_2O_5/CaO in the solution is sufficiently large. The best value for this ratio was found to be 4·6. If it is less than 3·0, then, even at 160°, the monocalcium phosphate monohydrate crystallises out.

*224. "Contributions to the study of the calcium phosphates. II. The action of ammonia gas on the calcium hydrogen orthophosphates." By Henry Bassett, jun.

It was found that under certain conditions when the acid calcium phosphates were treated with ammonia gas, absorption of the latter took place. The cause of this and the reactions occurring have been investigated with the following results:

$CaHPO_4$ does not absorb ammonia either at the ordinary temperature or at 100°.

$CaHPO_4,2H_2O$ does not absorb ammonia at the ordinary temperature, but if heated in the gas to 100°, vigorous absorption takes place with formation of a mixture of tricalcium- and ammonium phosphates according to the equation:

$$3CaHPO_4,2H_2O + 2NH_3 = Ca_3(PO_4)_2 + (NH_4)_2HPO_4 + 6H_2O.$$

When $CaHPO_4,2H_2O$ is heated, it would seem that at a temperature of about 80°, one of the quintuple points of the system $CaO - P_2O_5 - H_2O$ is reached. At this temperature the dihydrate breaks up into a mixture of $CaHPO_4,Ca_3(PO_4)_2$ and solution, and it is in this solution that the above reaction with ammonia takes place.

$CaH_4(PO_4)_2$ absorbs ammonia very slowly at the ordinary temperature, but rapidly at 100° with formation of the compound $Ca(NH_4)_2H_2(PO_4)_2$. This compound is not stable in presence of water, which at once decomposes it into $CaHPO_4$ and $(NH_4)_2HPO_4$. This explains why, when $CaH_4(PO_4)_2H_2O$ reacts with ammonia gas, a mixture of $CaHPO_4$, $Ca_3(PO_4)_2$, and $(NH_4)_2HPO_4$ is formed.

The commencement of the ammonia absorption by the $CaH_4(PO_4)_2,H_2O$, is probably due to formation of the above calcium ammonium phosphate. This, however, liberates water of crystallisation, which at once forms some solution in which the reaction proceeds. Although this reaction first leads to the formation of $CaHPO_4$, this can further react with ammonia as long as any solution is present.

It is to this further reaction that the presence of $Ca_3(PO_4)_2$ in the final product is due.

DISCUSSION.

Dr. VELEY asked if the author had dried the ammonia gas, and if the phosphates experimented upon were quite free from traces of adherent moisture. It appeared that the subsequent solution in water of the products obtained introduced a very essential disturbing factor.

Dr. BASSETT, in reply, said that the ammonia used had been dried by passing over solid caustic soda and sodium wire, but, of course, such ammonia was not absolutely dry. The calcium phosphates used in the experiments were also as free from adherent moisture as was possible without extreme precautions. With regard to the examination of the reaction products by treatment with water, the author realised the dangers of the method and the possibility of reactions occurring during this treatment. The method had, however, been employed as being the only one which would enable one to distinguish between, for instance, a mixture of $Ca_3(PO_4)$ and $(NH_4)_2HPO_4$, and a compound $Ca(NH_4)PO_4$, and he considered that the difficulty caused by possible reactions during the extraction with water had been satisfactorily overcome in each particular case in the manner described in the paper.

*225. "Relation between chemical constitution and physiological action in the tropeines." By Hooper Albert Dickinson Jowett and Frank Lee Pyman.

Reference was made to Ladenburg's generalisation, according to which a tropeine in order to possess mydriatic action must contain a benzene nucleus and a fatty hydroxyl in the side chain containing the carboxyl group, and also to a recent paper by Jowett and Hann (*Trans.*, 1906, 89, 357), in which it was stated that terebyl- and phthalidecarboxyl-tropeines, which are lactones, and do not contain fatty hydroxyl groups, produce, nevertheless, marked dilatation of the pupil, and lose their physiological activity when converted into the corresponding hydroxy-acids.

The authors have prepared the *lactone* of o-*carboxyphenylglyceryltropeine*, expecting to find it very active physiologically, since it is not only a lactone, but also conforms to Ladenburg's generalisation, iso*coumarincarboxyltropeine* which results on heating the above, and certain alkyl bromides of these tropeines and of homatropine.

The physiological examination showed that these tropeines are only slightly mydriatic, and that their physiological activity is lost when they are converted into the corresponding hydroxy-acids. The authors conclude that Ladenburg's generalisation cannot be maintained since it does not hold good either in the case of terebyltropeine or of the lactone of *o*-carboxyphenylglyceryltropeine, but that the difference in activity between a lactone and its corresponding hydroxy-acid possesses important physiological significance.

226. "Some derivatives of salicylic acid."
By Hooper Albert Dickinson Jowett and Frank Lee Pyman.

In the course of the production of some derivatives of salicylic acid which might possibly find application in medicine, *cinnamoylsalicylic acid*, its *methyl* and *ethyl esters*, and *quinine salt*, and also 3 : 5-*dichloroacetylsalicylic acid* were prepared and characterised.

Cinnamoylsalicylic Acid, $CO_2H \cdot C_6H_4 \cdot O \cdot CO \cdot CH\colon CHPh$.

Ten grams of salicylic acid and 12 grams of cinnamoyl chloride were heated together on a water-bath during three-and-a-half hours. The end of the reaction was indicated by the mixture becoming quite solid. After two recrystallisations from benzene, *cinnamoylsalicylic acid* was obtained in a pure state, and in quantity amounting to 48 per cent. of the theoretical yield ; it crystallises from benzene in needles melting at 155°: is very readily soluble in alcohol or ether, sparingly so in chloroform or benzene, and almost insoluble in water:

0·2409 gave 0·6316 CO_2 and 0·0981 H_2O. C = 71·5; H = 4·5.
$C_{16}H_{12}O_4$ requires C = 71·6; H = 4·5 per cent.

The *Quinine Salt*, $C_{16}H_{12}O_4,C_{20}H_{24}O_2N_2$, crystallises from alcohol in needles which melt at 169°. It is almost insoluble in water or cold alcohol:

0·2151 gave 0·5729 CO_2 and 0·1208 H_2O. C = 72·5; H = 6·2.
$C_{16}H_{12}O_4,C_{20}H_{24}O_2N_2$ requires C = 72·9; H = 6·1 per cent.

The *Methyl Ester* was prepared by the condensation of molecular quantities of cinnamoyl chloride and methyl salicylate by means of anhydrous potassium carbonate. The product was purified by first treating with hot water, dissolving in chloroform, drying this solution, and mixing the oil which resulted after the removal of the solvent with light petroleum. On then recrystallising from alcohol, the pure ester was obtained in large, tabular crystals melting at 71° and in an amount equal to 63 per cent. of the theoretical yield:

0·2320 gave 0·6144 CO_2 and 0·1049 H_2O. C = 72·2; H = 5·0.
$C_{17}H_{14}O_4$ requires C = 72·3; H = 5·0 per cent.

The *Ethyl Ester*, obtained in an analogous manner, crystallises from alcohol in fine needles melting at 66—67°:

0·2433 gave 0·6476 CO_2 and 0·1182 H_2O. C = 72·6; H = 5·4.
$C_{18}H_{16}O_4$ requires C = 72·9; H = 5·4 per cent.

3:5-*Dichloroacetylsalicylic Acid*, $C_9H_6O_4Cl_2$.

This substance was prepared by the acetylation of 3:5-dichlorosalicylic acid with acetic anhydride and sodium acetate. It crystallises from benzene in needles melting at 159°:

0·3350 gave 0·5328 CO_2 and 0·0732 H_2O. C = 43·4; H = 2·4.
0·2060 ,, 0·2358 AgCl. Cl = 28·3.
$C_9H_6O_4Cl_2$ requires C = 43·4; H = 2·4; Cl = 28·5 per cent.

227. "The addition of bromine to cinnamic acid and its esters. Preliminary notice." By John Joseph Sudborough and John Thomas.

The appearance of a communication from W. Herz and Bruno Mylius in the last number of the *Berichte* (1906, 39, 3816) on the velocity of the addition of bromine to cinnamic acid induces us to give a preliminary account of experiments made by us on the same subject. All our experiments were conducted in pure dry carbon tetrachloride at 15°. The bromine used was the commercial product dried with sulphuric acid. We find that the velocity varies enormously according as the reaction proceeds in the dark or in daylight.

The following numbers calculated by means of the equation for a bimolecular reaction, when molecular proportions of bromine and of cinnamic acid, namely, some 0·0333 mol. per litre, are used, show this clearly.

Cinnamic Acid.—K (in dark). Series 1: 0·0054, 0·0044, 0·0066, 0·010, 0·013. Series 2: 0·0072, 0·0074, 0·0066, 0·012.

K (in diffused daylight). Series 1: 0·28, 0·33, 0·36, 0·33. Series 2: 0·41, 0·37, 0·31, 0·34, 0·30, 0.31.

Similar results have been obtained when the methyl and ethyl esters are used.

Methyl ester.—K (in dark). Series 1: 0·0058, 0·0060, 0·0058, 0·0089, 0·0089, 0·0081. Series 2: 0·0047, 0·0047, 0·0039, 0·0062, 0·0089, 0·0071. Series 3: 0·0049, 0·0091, 0·0071, 0·0079, 0·0095.

Ethyl ester.—K (in dark). Series 1: 0·0085, 0·0074, 0·0077, 0·010, 0·011, 0·012. Series 2: 0·0071, 0·0074, 0·0053, 0·0076, 0·012, 0·010 Series 3: 0·0044, 0·0048, 0·0050, 0·0050, 0·0049.

(In diffused daylight) 0·29, 0·25, 0·25, 0·30. (In sunlight) 1·85, 1·70, 1·60, 1·29, 1·62, 1·49.

The velocity constant with crotonic acid is smaller than with cinnamic acid.

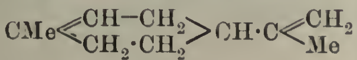
Crotonic acid (in dark) K = 0·00096, 0·00094, 0·00069, 0·00101.

All the experiments were made in glass-stoppered bottles, not in sealed tubes; those conducted in the dark were in amber-brown coloured, the others in colourless bottles.

We wish to extend the work in the direction of studying the effect of the introduction of various substituents into the crotonic and cinnamic acid molecules.

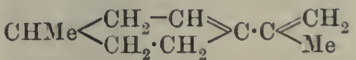
228. "The optical and magneto-optical influence of ethenoid linkings attached to contiguous carbon atoms." By Julius Wilhelm Brühl.

It has been found by Sir W. H. Perkin that limonene and dipentene (I), and $\Delta^{3:8(9)}$-*p*-menthadiene (II).



$$\mathrm{CMe}<\begin{matrix}\mathrm{CH{-}CH_2}\\ \mathrm{CH_2{\cdot}CH_2}\end{matrix}>\mathrm{CH{\cdot}C}<\begin{matrix}\mathrm{CH_2}\\ \mathrm{Me}\end{matrix}$$

(I.)



$$\mathrm{CHMe}<\begin{matrix}\mathrm{CH_2{-}CH}\\ \mathrm{CH_2{\cdot}CH_2}\end{matrix}>\mathrm{C{\cdot}C}<\begin{matrix}\mathrm{CH_2}\\ \mathrm{Me}\end{matrix}$$

(II.)

exhibit a remarkable difference in magnetic rotation, the values of (II) being much higher than those of (I). The author showed that this is due to the presence of two double linkings in the position $-\mathrm{C}\!:\!\mathrm{C}\cdot\mathrm{C}\!:\!\mathrm{C}-$ in the molecule of $\Delta^{3:8(9)}$-*p*-menthadiene.

229. "A difficulty in the theory of valency of W. Barlow and W. J. Pope." By David Leonard Chapman.

In the last number of the Transactions (p. 1675), W. Barlow and W. J. Pope claim to have demonstrated that the doctrine of valency follows as a necessary consequence of certain simple assumptions as to the nature and mode of packing of the atoms. The consequences of the theory have not as yet been fully worked out; for the present, therefore, it will be best to restrict any remarks to an examination of the premisses. An analysis of these has disclosed a difficulty which appears to be of importance and to necessitate some modification of the fundamental assumptions.

In the paper in question the following is laid down as the first geometrical property of spheres: "If in a close-packed assemblage of spheres, single spheres or groups of two or more, selected homogeneously, are replaced homogeneously by other groups of spheres in such a way that the resulting assemblage is close-packed without resorting to remarshalling, the replacing group is of practically the same relative magnitude as the group replaced, and possesses the same fundamental valency" (*Trans.*, p. 1724).

A second geometrical property is stated thus: "If a sphere of volume m (an atom of valency m) is replaced by one of volume $m + n$ (valency $m + n$) one or more additional spheres (atoms) having the total volume n (valency n) must be simultaneously inserted in order that the close-packing may be re-established without remarshalling" (*Trans.*, p. 1729—1730).

It is declared that from these propositions the law of the equivalence of elements and compound radicles can be immediately deduced, and the fact that an element of fundamental valency m can function as one of valency $m + 2n$ is said to receive by means of them a rational explanation.

It will now be shown that different results can be deduced from the propositions in question. Consider a close-packed homogeneous assemblage, the similar parts of which are built up of spheres of the relative volumes

$$2n_1,\ 2n_2 \ldots\ldots\ldots\ldots 2n_n,\ 2\ ;$$

where n_1, n_2, &c., are whole numbers.

Replace the sphere of volume 2 by two spheres each of volume 1. According to the geometrical property of spheres formulated first above, this can be done without remarshalling being involved. Now replace one of the spheres of volume 1 by two spheres of respective volumes 2 and 1, and finally replace the two spheres of unit volume by a single sphere of volume 2. The original system has now been converted into one composed of spheres of volumes represented by the numbers

$$2n_1, 2n_2 \ldots\ldots\ldots\ldots 2n_n, 2, 2$$

without remarshalling, and by three substitutions in two of which the first geometrical property and in one of which the second geometrical property have been assumed to hold.

Now we are not concerned with the absolute dimensions of the system, and therefore the initial group of spheres can be regarded as consisting of spheres of the volumes

$$n_1, n_2 \ldots\ldots\ldots\ldots n_n, 1,$$

and the final group of spheres can be regarded as consisting of spheres of the volumes

$$n_1, n_2 \ldots\ldots\ldots\ldots n_n, 1, 1,$$

the marshalling being the same in both cases.

Therefore two spheres of volume 1 can function as one sphere of volume 1. By similar reasoning it can be shown that a sphere of volume 2 can function as a sphere of volume 1, and in general that a sphere of any size can replace any other without any resort to remarshalling being necessary.

From the foregoing argument it would appear that the two propositions quoted above cannot be used alone (in their present unqualified form at any rate) to demonstrate that valency is a simple volume relation. A formal statement, from the authors, of the restrictions to be put upon their use would be of value.

230. "On the more exact determination of the densities of crystals."

By the Earl of Berkeley.

A conical pyknometer with thermometer stopper and graduated side tube is used, and instead of filling to a mark, the author relies on the evaporation of the liquid (round the neck) to bring the level in the capillary side-tube within the graduations.

The liquid used is carbon tetrachloride, and care is taken that the temperature of the balance case varies but little while the pyknometer is being weighed.

The air adhering to the crystals is expelled by causing a current of carbon tetrachloride vapour to pass over them when in an exhausted vessel, and the pyknometer is filled while still in this vacuous space. A desiccator was described whereby hygroscopic salts may be dried in a current of hot air, and the pyknometer filled in a vacuum. Results for the density of quartz, barytes, and potassium carbonate were given. The maximum difference between any two observations out of eleven on quartz, and out of nine on barytes, is 0·02 per cent. The experiments on potassium carbonate do not agree so closely.

231. "A relation between the volumes of the atoms of certain compounds at the melting points and their valencies. Interpretation by means of the Barlow-Pope theory." By Gervaise Le Bas.

The molecular volumes of complex paraffins and alcohols can be calculated very exactly by means of the formula:

$$\text{M. V. of } C_nH_{2n+2} = (6n+2)S = 6nS + 2S,$$

where S is a constant which has an average value of 2·970 and is called the unit-stere. It is a measure of the volume of hydrogen. Carbon, in accordance with its valency, is equal to 4S. The value of S is also obtained by dividing the difference for CH_2 by 6. The numbers obtained in this way confirm the previous values.

Certain alcohols up to heptadecyl carbinol, $C_{18}H_{37}OH$, have also been studied and their volumes are calculated by means of the expression

$$\text{M. V. of } C_nH_{2n+1}OH = (6n+4)S = 6nS + 4S,$$

S having the same value as in the former series. Oxygen is thus found to have a volume equal to 2S in accordance with its valency-number.

These results were discussed in the light of the Barlow-Pope theory (*Trans.*, 1906, **89**, 1675).

232. "The action of acid chlorides on thioureas." By Augustus Edward Dixon and John Hawthorne.

In former communications it has been shown that alkyl and aryl chlorocarbonates unite with thiourea, forming the hydrochlorides of basic derivatives, or pseudo-thioureas, $NH_2·C(NH)·S·CO_2·R$; it is now established that Claus' compound of thiourea and acetyl chloride (*Ber.*, 1875, **8**, 42) is similarly constituted.

Acetyl chloride unites spontaneously with monosubstituted arylthioureas, yielding compounds of the form

$$ArNH·C(NH)·S·COMe,HCl;$$

from these the corresponding picrates may be prepared. On withdrawing the combined hydrochloric acid by calcium carbonate or sodium ethoxide, the odour of thioacetic acid becomes perceptible;

hence the base is probably liberated and then hydrolysed to a slight extent. Nevertheless, the product left on evaporation of the solution is not the free base, but an isomeride, the acetyl group having migrated from the sulphur to a nitrogen-atom, so as to yield

$$\mathrm{AcArN{\cdot}CS{\cdot}NH_2}.$$

The latter compound is known to change readily, by migration of its acyl group, into another isomeride, namely, the symmetrical $\mathrm{AcNH{\cdot}CS{\cdot}NHAr}$: it appears, therefore, that by this series of transfers the acetyl group may be passed, in a given thiourea molecule, from point to point, until it has occupied, in succession, every position of attachment which a substituting group can assume. If the hydrogen chloride is eliminated by heat alone, the symmetrical or *ab*-thiocarbamide is produced; in like manner, Claus' compound yields acetylthiourea.

Benzoyl chloride behaves with thiourea and its aryl monosubstitution derivatives similarly to acetyl chloride; both chlorides unite with *ab*-aryl disubstituted thiocarbamides to form molecular additive products, the constitution of which has not yet been determined.

Disubstituted carbamic chlorides unite with thiourea, forming haloid salts; the corresponding nitrates and picrates are sparingly soluble in water.

Organic acid chlorides do not appear to combine with thioureas which already contain an acidic group.

233. "3-Hydroxyphthalic and 3-methoxyphthalic acids and their derivatives." By William Henry Bentley, Rona Robinson, and Charles Weizmann.

An account was given of the preparation of 3-methoxyphthalic acid by the oxidation of 1:5-methoxynaphthol with alkaline permanganate, and of 3-hydroxyphthalic acid by fusion of 3-methoxyphthalic acid with caustic potash. A number of derivatives of each acid were described.

234. "4-Hydroxyphthalic and 4-methoxyphthalic acids." By William Henry Bentley and Charles Weizmann.

The preparation of pure 4-hydroxyphthalic acid (m.p. 205°) from sulphophthalic acid by fusion with caustic potash was described, together with a number of derivatives of this acid.

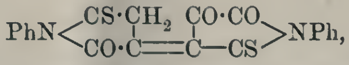
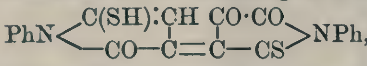
235. "Derivatives of Naphthacenequinone." By William Henry Bentley, Arthur Friedl, Frederick Thomas, and Charles Weizmann.

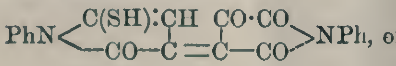
This paper is a fifth contribution to the Chemistry of naphthacenequinone (compare Diechler and Weizmann, Orchardson and Weizmann, *Ber.*, 1903, **36**, 547, 719, 2326; *Trans.*, 1906, **89**, 116), and contains a description of the preparation and properties of a large number of new hydroxy- and aminohydroxy-derivatives of this series.

236. "Dithioxanthoxalanil (Preliminary note)."

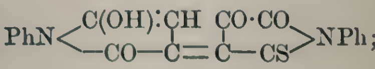
By Siegfried Ruhemann.

Thioacetanilide reacts with ethyl oxalate in the presence of sodium ethoxide to yield a compound similar to those which are formed from acetanilide and its homologues (Ruhemann, *Trans.*, 1906, **89**, 1236; *Proc.*, 1906, **22**, 284).

Dithioxanthoxalanil,  $\mathrm{PhN}<\begin{matrix}\mathrm{CS\cdot CH_2\quad CO\cdot CO}\\ \mathrm{CO\cdot C{=}{=}C{-}CS}\end{matrix}>\mathrm{NPh}$, crystallises from glacial acetic acid in brown needles which decompose at about 235°. It differs from xanthoxalanil inasmuch as it is more stable towards caustic potash. The dilute alkali, or sodium carbonate, dissolves it on warming and transforms it into its *tautomeride*,  $\mathrm{PhN}<\begin{matrix}\mathrm{C(SH){:}CH\quad CO\cdot CO}\\ \mathrm{{-}CO{-}C{=}C{-}CS}\end{matrix}>\mathrm{NPh}$, which crystallises from alcohol in red needles decomposing at 195°, and is soluble in cold sodium carbonate. On boiling with caustic potash (10 to 15 per cent.) one atom of sulphur is removed as hydrogen sulphide, and replaced by oxygen; the compound, *thioxanthoxalanil*, which is thus formed, crystallises from alcohol in shiny, orange plates which decompose at 216—218°, and are soluble in sodium carbonate. The constitution of this substance is either



$\mathrm{PhN}<\begin{matrix}\mathrm{C(SH){:}CH\quad CO\cdot CO}\\ \mathrm{{-}CO{-}C{=}C{-}CO}\end{matrix}>\mathrm{NPh}$, or



$\mathrm{PhN}<\begin{matrix}\mathrm{C(OH){:}CH\quad CO\cdot CO}\\ \mathrm{{-}CO{-}C{=}C{-}CS}\end{matrix}>\mathrm{NPh}$;

it is only decomposed by being heated with concentrated caustic potash (60 to 70 per cent.), when oxalic acid and aniline are formed.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Roscoe, *Sir Henry Enfield.* The life and experiences of Sir Henry Enfield Roscoe, D.C.L., LL.D., F.R.S. Written by himself. pp. xii + 420. ill. London 1906. (*Recd.* 17/12/06.) From the Author.

Titherley, *Arthur W.* A laboratory course of organic chemistry, including qualitative organic analysis. pp. viii + 235. ill. London 1906. (*Recd.* 19/12/06.) From the Author.

Tschirch, *Alexander.* Die Harze und die Harzbehälter mit Einschluss der Milchsäfte. Historisch-kritische und experimentelle, in Gemeinschaft mit zahlreichen Mitarbeitern ausgeführte Untersuchungen. 2 Auflage. 2 vols. pp. xxii + 1268. ill. Leipzig 1906. (*Recd.* 28/11/09.)

From the Publishers : Gebrüder Borntraeger.

II. *By Purchase.*

Groth, *Paul Heinrich.* Chemische Krystallographie. Teil I. Elemente. Anorganische Verbindungen ohne Salzcharakter. Einfache und complexe Halogenide, Cyanide und Azide der Metalle, nebst den zugehörigen Alkylverbindungen. pp. viii + 626. Leipzig 1906. (*Recd.* 19/12/06.)

Post, *Julius.* Chemisch-technische Analyse. Handbuch der analytischen Untersuchungen zur Beaufsichtigung chemischer Betriebe. 3 Auflage. Bände I. i. und II. i. pp. 180, 208. ill. Braunschweig 1906. (*Recd.* 19/12/06.)

Procter, *Henry Richardson.* The principles of leather manufacture pp. xvi + 512. ill. London 1903. (*Recd.* 6/12/06.)

III. *Pamphlets.*

Blount, *Bertram.* Recent progress in the cement industry. A paper read before the Society of Chemical Industry on June 11th, 1906. pp. 48.

White, *Americus Frederic.* Composition of the waters of Rockbridge County, Virginia, and their relation to the geological formations. pp. 38. Winchester, Va. 1906.

At the next Ordinary Meeting, on **Thursday**, January **17th**, 1907, the following papers will be communicated :

"The relation between absorption spectra and optical rotatory power. Part I. The effect of unsaturation and stereo-isomerism." By A. W. Stewart.

"Organic derivatives of silicon. Part II. The synthesis of *dl*-benzylethylpropylsilicol, its sulphonation, and the resolution of the sulphonic derivatives into optically active components." By F. S. Kipping.

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OF THE

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OF THE

CHEMICAL SOCIETY.

CORRECTED TO OCTOBER, 1906.

BURLINGTON HOUSE,
LONDON, W.
1906.

OFFICERS AND COUNCIL,

ELECTED MARCH 30th, 1906.

PRESIDENT.

RAPHAEL MELDOLA, F.R.S.

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Professor R. Meldola (President), Dr. A. Scott (Treasurer), Dr. M. O. Forster and Prof. A. W. Crossley (Hon. Secretaries), and Sir William Ramsay (Foreign Secretary), are *ex officio* members of each Committee.

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Messrs. E. G. Hooper, G. T. Moody, H. T. Brown, T. E. Thorpe, W. A. Tilden, and the Officers.

HOUSE COMMITTEE.

Messrs. W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. M. Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

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Messrs. E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. Millar Thomson (Chairman), J. A. Voelcker, J. Wade, the Editor, and the Officers.

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The Ordinary Scientific Meetings for 1906-7 will be held on the following Thursdays at 8.30 p.m. :—

October 18th, 1906
November 1st, ,,
,, 15th, ,,
December 6th, ,,
,, 20th, ,,
January 17th, 1907
February 7th, ,,
,, 21st, ,,

March 7th, 1907
,, 21st, ,,
April 18th ,,
May 2nd, ,,
,, 16th, ,,
June 6th, ,,
,, 20th ,,
July 4th ,,

Annual General Meeting, Friday, March 22nd, 1907, at 4 p.m.

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THE CHEMICAL SOCIETY.

The Chemical Society was founded on February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice thereof from the Secretaries.

Each Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications so long as his Annual Subscription be not in arrear. He is also entitled to the use of the books in the Society's Library, under such restrictions as the Council may deem necessary. He has the privilege of introducing to Ordinary Meetings of the Society, two visitors, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

When elected, every Candidate previous to admission is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee ; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due

on the first day of January of every year. The life composition fee is £30, excepting that Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If a Candidate be elected during the month of November or December, he will not be called upon to pay any annual subscription for the current year, and will not be entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March owes two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, shall cease to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

PUBLICATIONS OF THE SOCIETY.

The following is a list of the Publications of the Society:

	Price per Vol. to Fellows.			Price per Vol. to Public.		
	£	s.	d.	£	s.	d.
Memoirs and Proceedings, 1841–1847 (3 Vols.)	1	0	0	1	10	0
†Quarterly Journal, 1848–62 (14 Vols.)	1	0	0	1	10	0
†Journal, 1862–1895	1	10	0	1	10	0
do. 1896—present date	2	0	0	2	0	0
†Proceedings, 1885—present date		7	6		7	6
Annual Reports on the Progress of Chemistry, Vol. I., 1904 (bound in cloth)		4	6		4	6
do. do. Vol. II.,		4	6		4	6
Collective Index, Vol. I. 1841–1872		4	0		4	0
* do. Vol. II. 1873–1882		10	0		15	0
* do. Vol. III. 1883–1892		15	0	1	0	0
* do. Vol. IV. 1893–1902	1	0	0	1	10	0
Jubilee Volume, 1891		6	0		6	0
Memorial Lectures, 1893–1900		7	6		7	6
Library Catalogue, 1886		1	0		1	0
do. 1903		2	6		2	6

Tables of International Atomic Weights (as recommended by the International Atomic Weights Com.)... 1/6 per doz.; 12/- per hundred.

† The Society cannot supply complete sets of these.

* Postage 1s. extra.

The *Journal*, which is issued monthly, contains papers communicated to the Society, Memorial Lectures on the life and work of eminent Fellows deceased, together with abstracts of all papers relating to chemistry and closely connected branches of science published in other journals, British and foreign.

The *Proceedings* contains a short report of the business at each meeting, and abstracts of all papers presented to the Society. It is usually published about seven days after the meeting. It serves as a medium of publication, not only for the abstracts of papers which subsequently appear in full in the Journal, but also for short papers and preliminary communications.

The Annual Reports on the Progress of Chemistry give an epitome of the principal definite steps made in the advancement of Chemistry during the year.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have decided that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. Papers which, on the report of referees, are deemed by the Council unsuitable for publication in the Transactions, are deposited in the Society's Archives. In all cases, an abstract of the paper, not exceeding three hundred words in length, should be supplied for insertion in the Proceedings.

Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. The Committee meets twice a year to consider applications for grants, and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

NAMES OF HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. Svant August, Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
May 18, 1904	Becquerel, Prof. Antoine Henri, LL.D. (Aberd.), 6, Rue Dumont d'Urville, XVI. Paris
Feb. 1, 1883	Beilstein, Geh. Rath Prof. Dr. Fedor, W.O., 8th line, No. 17, St Petersburg
Mar. 1, 1860	Berthelot, Prof. Marcellin, Membre de l'Institut, F.R.S., Collège de France, Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. Stanislao, F.R.S., Reale Università, Rome
May 18, 1904	Clarke, Prof. Frank Wigglesworth, LL.D. (Aberd.), United States Geological Survey, Washington, D.C., U.S.A.
May 18, 1904	Curie, Madame Marie, La Sorbonne, Paris
Jan. 20, 1898	Curtius, Geh. Rath Prof. Dr. Theodor, Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. Emil, Aschaffenburg, Germany
June 16, 1892	Fischer, Geh. Rath Prof. Dr. Emil, F.R.S., Dorotheenstr. 10, Berlin
Feb. 1, 1883	Fittig, Prof. Dr. Rudolph, Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. Antoine Paul Nicolas, Rapenburg 104, Leyden
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Westendstrasse 28, Frankfurt a. Main, Germany
Feb. 2, 1888	Hoff, Prof. Dr. Jacobus Henricus van't, F.R.S., Lietzenburgerstrasse 54, Berlin, 15, W.
Jan. 20, 1898	Körner, Prof. Wilhelm, R. Scuola superiore d'agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath Prof. Dr. Albert, Kaiser Wilhelmstrasse 108, Breslau
Feb. 2, 1888	Landolt, Geh. Rath Prof. Dr. Hans, Albrechtstrasse 14, Berlin, N.W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Mölkerbastei 5, Vienna I.
May 18, 1904	Liebermann, Geh. Rath Prof. Dr. Carl, Matthäikirchstrasse 29, Berlin, W.

* Faraday Lecturer, 1872.

Date of Election.	
Feb. 1, 1883	*Mendeléeff, Prof. Dr. Dmitri Ivanovitsch, F.R.S., 19, Zabalkansky, St. Petersburg
Jan. 20, 1898	Menschutkin, Prof. Dr. Nicolai, Sosnovka, Polytechnikum, St. Petersburg
Jan. 20, 1898	Moissan, Prof. Henri, Rue Vauquelin 7, Paris
May 18, 1904	Morley, Prof. Edward Williams, West Hartford, Conn., U.S.A.
Jan. 20, 1898	†Ostwald, Geh. Rath Prof. Dr. Wilhelm, LL.D. (Aberd.), Grossbothen, Kgr., Sachsen
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Théophile, Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. Walthère, Rue Beckmann 32, Liége
May 18, 1876	Thomsen, Prof. Dr. Julius, F.R.S., Lindevei 13, Copenhagen
Jan. 20, 1898	Troost, Prof. Louis Joseph, Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. Johannes Diderik van der, T.C., Hooftstraat 117, Amsterdam

* Faraday Lecturer, 1889.

† Faraday Lecturer, 1904.

FARADAY LECTURERS.

1869. Jean Baptiste André Dumas.
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1875. August Wilhelm von Hofmann.
1879. Charles Adolphe Wurtz.
1881. Hermann Ludwig Ferdinand von Helmholtz.
1889. Dmitri Ivanovitsch Mendeléeff.
1895. Lord Rayleigh.
1904. Wilhelm Ostwald.

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1903. William Jackson Pope.
1906. Walter Noël Hartley.

In order that the List of Fellows may be as nearly complete as possible, those Fellows whose names and degrees do not appear in full are requested to communicate with the Assistant Secretary. Inaccuracies should be reported without delay.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society ; V.P. as Vice-President ;
S. as Secretary ; T. as Treasurer ; F.S. as Foreign Secretary ; P. as President.

Date of Election.			
1903	Trans.		Abell, Robert Duncombe, D.Sc. (Wales), Ph.D. (Leipzig), F.I.C., University College of South Wales and Monmouthshire, Cardiff
1871	Trans.	C. 1882-4	Abney, Sir William de Wiveleslie, K.C.B., Hon. D.C.L. (Dun.), Hon. D.Sc. (Vict.), Sc.D. (Dub.), F.R.S., F.I.C., Rathmore Lodge, Bolton-gardens-south, S.W.
1883			Abraham, Alfred Clay, F.I.C., 87, Bold-street, Liverpool
1890			‖Abrines, Gustavus Anthony, Sanitary Commissioner's Office, Gibraltar
1904			Ackroyd, John Prest, B.Sc. (Lond.), 116, Richmond-street, Accrington, Lancs.
1875	Trans.		Acworth, Joseph John, Ph.D. (Erlangen), F.I.C., Thornbank, Shootup-hill, Brondesbury, N.W.
1905			Adam, Adam Lawson Kelly, 296 Bath-street, Glasgow.
1892			Adams, Arthur, F.I.C., Kelvin House, Edgbaston-road, Smethwick
1888			Adams, Charles Mansley, Albany-buildings, Lord-street, Southport
1877	Trans.		‖Adams, Matthew Algernon, F.R.C.S. (Eng.), F.I.C., The Kulm, Bearsted, near Maidstone
1901			Adams, Ormsby Gore, School of Mines, Thames, Auckland, New Zealand
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helens, Lancs.
1896			Addie, Robert, Messrs. Kennedy and Addie, Norfolk House, Laurence Pountney Hill, E.C.
1881	Trans.		Adeney, Walter Ernest, Hon. D.Sc. (R.U.I.), A.R.C.S.I., F.I.C., Royal University of Ireland, Earlsfort-terrace, Dublin
1885	Trans.		Adie, Richard Haliburton, B.Sc. (Lond.), M.A. (Cantab.), 136, Huntingdon-road, Cambridge
1885			Adriance, John Sabine, Ph.D., The Union League Club, New York, U.S.A.
1906			Agar, Shelton Gottlieb, Panorama House, Guernsey, Channel Islands

Date of Election.		
1905	Trans.	Ahlum, Charles Chester, c/o Messrs. G. W. Lord and Co., Philadelphia, Pa., U.S.A.
1901		Aitken, Andrew Charles, c/o The Burma Oil Co., Ltd., Rangoon, Burma
1879		Albright, George Stacey, M.A. (Cantab.), Bromesberrow-place, Ledbury
1893		Albuquerque, John Pedrozo d', Prof., M.A. (Cantab.), F.I.C., Government Laboratory, Barbados, West Indies
1885		Alcock, Frank Harris, F.I.C., 9, Broad-street Corner, Birmingham
1892		Alcock, John While, Central Brewery, 45, Mott-street, Birmingham
1902		Alder, John Frederick, 28, Claverly-grove, Church End, Finchley, N.
1903		Alderton, Gilbert John, B.Sc. (Lond.), F.I.C., "The Nest," Eglinton-road, Plumstead, Kent
1888	Proc.	Alexander, John, M.A. (Glas.), Midfield, Perth
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, 55, Northern-grove, West Didsbury, near Manchester
1894		Allen, Frederick John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, Frederick Thomas, B.Sc. (Dun.), 32, Currock-terrace, Carlisle
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1904		Allen, William Harold Richard, c/o Straits Trading Co., Butterworth, Penang, Straits Settlements
1894		Allibon, George Henry, 19, Short-strand, Belfast
1905		Allison, James Albert, Luchana Laboratory, Apartado 45, Bilbao, Spain
1899		Allworthy, James Herbert, Nevski, Norwich-road, Thetford
1899		‖Allworthy, Samuel William, M.A., M.D., B.Ch. (Dub.), The Manor House, Antrim-road, Belfast
1903		Alton, William Lester St. John, A.I.C., Dungarvan, Putney Heath, S.W.
1905	Trans.	Amos, Arthur, B.A. (Cantab.), South-Eastern Agricultural College, Wye, Kent
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. (Oxon.), 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc. (Lond.), F.I.C., 31a, Clanricarde-gardens, W.
1895		Anderson, Herbert, Royal Latin School, Buckingham
1900		Anderson, James William, The Paddock, Halling, near Rochester
1906		Anderson, Robert, Chester-road-west, Sunderland
1901	Trans.	Anderson, William Carrick, M.A., D.Sc. (Glas.), 8, Windsor-quadrant, Kelvinside, Glasgow

Date of Election.			
1892			Anderson, William Smellie, Christmas Island, c/o Messrs. Boustead & Co., Singapore, Straits Settlements
1905	Trans.		Andrews, Albert Edward, St. Hilda, 20, Carew-road, Thornton Heath, S.E.
1888			Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882			Andrews, Launcelot Winchester, Ph.D. (Göttingen), 3731, Westminster-place, St. Louis, Mo., U.S.A.
1870			Andrews, Thomas, F.R.S., M.Inst.C.E., Ravencrag, Wortley, near Sheffield
1905	Trans.		Angel, Andrea, M.A. (Oxon.), 17, Banbury-road, Oxford
1877			Angell, John, F.I.C., 6, Beacon's-field, Derby-road, Withington, Manchester
1898	Trans.		Annable, Henry William Coupe-, Tungsten and Rare Metals Co., Ltd., Queen's-road, Battersea, S.W.
1905			Anthony, Charles, jun., M.Inst.C.E., Casilla de Correo, 149, Bahia Blanca, Argentine, South America
1879			‖Appleby, Herbert, 2, John Dalton-street, Manchester
1903			Appleyard, George Henry, F.I.C., Wilmington Oil Mills, 151, Cleveland-street, Hull
1890	Trans.		Appleyard, James Robert, Royal Technical Institute, Salford
1903			‖Appleyard, Percy, Albany, Western Australia
1884			Archbutt, Leonard, F.I.C., The Yews, Madeley-street, Derby
1875			Armistead, William, M.B., C.M. (Edin.), Stapleford, Cambridge
1900	Proc.		Armitage, Francis Paul, Colet House, Talgarth-road, West Kensington, W.
1903	Trans.		‖Armstrong, Edward Frankland, D.Sc. (Lond.), Ph.D. (Berlin), c/o Messrs. Huntley & Palmer, Reading
1900			Armstrong, Frederick William, 6, St. Thomas's-terrace, Wells, Somerset
1870	Trans.	C.1873-5 S. 1875-93 P.1893-5	‖Armstrong, Henry Edward, Prof., LL.D. (St. Andrews), Ph.D. (Lips.), F.R.S., 55, Granville-park, Lewisham, S.E., and Central Technical College, Exhibition-road, S.W.
1905			Arnaud, Francis William Frederick, F.I.C., The Town Hall, Portsmouth
1894			Ashdown, Charles Henry, Monastery-close, St. Albans
1903			Ashdown, Herbert Henry, 3, Genesta-road, Plumstead, Kent
1900			Ashton, James, Hacken Sewage Works, Moses Gate, Bolton
1905			Ashwell, James Henry, 117, Waterloo-crescent, Nottingham
1897			Ashworth, John Bright, 23, Temple-street, Liverpool
1901			Aspinall, Thomas, 42, Gilnow-road, Bolton
1900	Trans.		Aston, Bernard Cracroft, N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, William George, 12, Douglas-road, Goodmayes, Ilford, E.
1899			Atkinson, George Dekeyne, c/o Messrs. Alton & Co., Ltd., Wardwick Brewery, Derby

Date of Election.			
1903			Atkinson, Harford Montgomery, B.Sc. (Wales), Ph.D. Göttingen), 69, George-street, Limerick
1872	Trans.		‖Atkinson, Robert William, B.Sc. (Lond.), F.I.C., 44, Stuart-street, Cardiff
1862	Trans.	C. 1874-8	‖Attfield, John, Prof., M.A. and Ph.D. (Tübingen), F.R.S., F.I.C., Ashlands, Watford, Herts.
1903	Trans.		Attwell, Herbert Moore, A.R.C.S., Stoke Hill House, Limpley Stoke, Bath
1872	Trans.		‖Attwood, George, M.Inst.C.E., Durmast Lodge, Ringwood, Hants, and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1903			Aubrey, Henry James, The Cross, Worcester
1895	Trans.		‖Auden, Harold Allden, Central Laboratory, United Alkali Co., Widnes, Lancs.
1886			Audley, James Aloysius, B.Sc. (Lond.), A.R.C.S., F.I.C., c/o Messrs. G. Howson and Sons, Eastwood Sanitary Works, Hanley, Staffs.
1877			Austen, Peter Townsend, Ph.D., 204, West 86th-street, New York, U.S.A.
1906	Trans.		‖Austin, Percy Corlett, M.A. (Cantab.), Queen's College, Galway, Ireland
1892			Avery, David, Working Men's College, Melbourne, Australia
1896			Aykroyd, Henry Edward, Scaitcliffe, Queen's-road, Ilkley, Yorks.
1891			Aylan, John Charles, Manager Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1903			‖Badcock, William Cornish, M.A. (Cantab.), The Grammar School, Crediton, Devon
1904			Baguley, Allan, B.Sc. (Wales), F.I.C., University College of North Wales, Bangor
1875	Trans.		‖Bailey, George Herbert, Ph.D. (Heidelberg), D.Sc. (Lond.), The University, Manchester, and Marple Cottage, Marple, Cheshire
1895			Bailey, George Percy, M.A. (Dub.), Victoria Institute, Worcester
1903			Bailey, Harold James, A.I.C., Maritime Coke Works, Pontypridd, S. Wales
1893			Bailey, Henry, 6, Elsenham-road, Wimbledon Park, S.W.
1900	Trans.		Bain, Alexander William, B.A., B.Sc. (Lond.), A.I.C., Fairlight, Muswell-rise, Muswell Hill, N.
1884			‖Bain, Daniel, United Alkali Co., Ltd., Allhusen's Works, Gateshead-on-Tyne
1891			Bairstow, John, Burley, Queen's-park, Chester
1901			Baker, Arthur, 96, Blackburn-road, Darwen, Lancs.
1889			‖Baker, Charles Frederic, B.Sc. (Lond.), Ph.D. (Strassburg), Technical College, Sunderland

Date of Election			
1883	Trans.		‖Baker, Charles John, The Schools, Shrewsbury
1899			Baker, Clement Harrison, c/o Messrs. C. Harrold & Co., 2 and 3, St. Paul's-square, Birmingham
1902			Baker, Frederick Guy Stirling, Marryatt's Lodge, Snaresbrook, Essex
1900			Baker, Frederick Nolan, Lieut., R.A. Mess, Dover Castle, Dover, Kent
1881	Trans.		Baker, Harry, F.I.C., Epworth House, Moughland-lane, Runcorn. Cheshire
1884	Trans.	C. 1899-03	‖Baker, Herbert Brereton, M.A., D.Sc. (Oxon.), F.R.S., Christ Church, Oxford
1893	Trans.		Baker, Julian Levett, F.I.C., Stainesbury Holt, Kingston-road, Staines
1901			Baker, Thomas Thorne, 16, Rutland-park-mansions, Willesden Green, N.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon
1902			Ball, James Handby, M.Sc. (L'pool), A.I.C., Rathbane Cottage, Limerick, Ireland
1901	Trans.		Ball, Walter Craven, B.A. (Oxon.), Guy's Hospital, S.E.
1892			‖Ballantyne, Horatio, F.I.C., 75, Chancery-lane, W.C.
1896			Ballingall, William, M.A. (St. Andrews), Ardarroch, Dundee
1891	Trans.	C. 1905-	Baly, Edward Charles Cyril, F.I.C., University College, Gower-street, W.C.
1886			Bamber, Henry Kelway George, Ingress House, Greenhithe, Kent
1890	Proc.		Bamber, Montague Kelway, F.I.C., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1896			Banerjee, Gopal Chandra, Kaiser Soap Co., Cawnpore, India
1906			Banner, George Ernest, 10, Highfield-road, Rock Ferry, Cheshire
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, F.I.C., 59, Tregunter-road, S. Kensington, S.W.
1904	Trans.		Barbour, William, M.A. and B.Sc. (St. Andrews), Dalswinton, All Saints'-road, Peterborough
1905			Barbrook, George Henry, c/o Messrs. T. Prentice & Co., Stowmarket, Suffolk
1880			Barclay, Arthur Edward, 95, Farringdon-street, E.C.
1903	Trans.		‖Barger, George, M.A. (Cantab.), D.Sc. (Lond.), The Wellcome Physiological Research Laboratories, Brockwell Hall, Herne Hill, S.E.
1906			Barker, Arthur Ernest, B.A., B.Sc. (Lond.), 3, York-road, Chorlton-cum-Hardy, Lancs.
1903	Trans.		Barker, Thomas Vipond, B.A. and B.Sc. (Oxon.), Mineralogical Dept., University Museum, Oxford
1896			Barker, William Henry, B.Sc. (Lond.), Addiscombe, Empress-avenue, Wanstead Park, Essex

Date of Election.			
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1897			Barlow, Herbert William Leyland, M.A. and M.D. (Oxon.), M.R.C.S. and L.R.C.P. (Lond.), D.P.H., (Cantab.), Holly Bank, Croftsbank-road, Urmston, Manchester
1897			Barlow, William, The Red House, Stanmore, Middlesex
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W., and Dynamite Works, Modderfontein, near Zuurfontein, S. Africa
1905			Barnes, James Hector, B.Sc. (Birm.), A.I.C., The University Club, Birmingham
1875			‖Barnes, Richard Leburn, Phœnix Chemical Works, Hackney Wick, N.E.
1888			‖Barraclough, William Herbert, F.I.C., Mortomley, near Sheffield
1895			Barralet, Edgar Stuart, 6, Wellington-mansions, Queen's Club-gardens, W.
1891			Barratt, John Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward Louis, B.Sc. (Lond.), F.I.C., 12, Avenue de la Grande Armée, Paris
1906			Barrett, Ernest, B.Sc. (Lond.), 56, Elswick-road, Lewisham, S.E.
1901			Barrie, Thomas Stewart, 157, St. Vincent-street, Glasgow
1905	Trans.		Barrowcliff, Marmaduke, A.I.C., 25, Priory-road, Kew, Surrey
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, John Anthony, Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc. (Virginia), Ph.D. (N. Carolina), College of the City of New York, New York, U.S.A.
1864	Trans.	{C. 1870-3, 90-3}	‖Bassett, Henry, F.I.C., 26, Belitha-villas, Barnsbury, N.
1891			Bate, William, Ladbroke, Hayle, Cornwall
1893			Bateman, John, c/o Messrs. J. C. and J. Field, The Marsh, Lambeth, S.E.
1896			Bathurst, Charles, jun., B.A. (Oxon.), 3, Stone-buildings, Lincoln's Inn, W.C.
1905			Baxter, John George, c/o Mrs. Burgess, 143, Milton-road, Gravesend, Kent
1896			Bay, Lauritz Hansen, B.Sc. (Lond.), Deacon's School, Peterborough
1892			Bayliss, Charles, Mino, Castle Bromwich, near Birmingham
1874			Bayly, F. W., The Royal Mint, Sydney, N.S.W.
1903			Bayly, Harold Goodenough, F.I.C., Moatside, Bedford
1874			‖Bayne, James, F.I.C., 31, Vaughan-terrace, Harrow
1879			‖Bayne, William Thirlwall, LL.D. (Cantab.), Brockhill, Broad Clyst, Exeter
1897			Beadle, Alec Alfred, Greenheys, Granville-road, High Barnet
1891	Trans.		Beadle, Clayton, Halewood, Sidcup, Kent
1861			‖Beadnell, Charles Edward, Major, R.A., Hafod, Llandinam, Montgomeryshire, R.S.O.

Date of Election.			
1903			Beadnell, Charles Marsh, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Fleet Surgeon, H.M.S. *New Zealand*, Atlantic Squadron, Gibraltar
1867			Beale, William Phipson, K.C., M.P., 10, New-court, Carey-street, Lincoln's Inn, W.C. ; and 2, Whitehall-court, S.W.
1905			Bealey, Edward Williams, B.A. (Cantab.), 55, Belsize-park-gardens, Hampstead, N.W.
1903			Beam, William, M.A., M.D. (Penn.), F.I.C., Chemical Laboratory, Gordon College, Khartoum, Soudan
1899			Bean, Percy, 17, Dickinson-street, Manchester
1902			Beanes, Alfred Edward, Falcon Works, Wallis-road, Hackney Wick, N.E.
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, George Russell, L.R.C.P. (Lond.), M.R.C.S. (Eng.), L.S.A., D.P.H. (Cantab.), Warwick House, Upper-street, Islington, N.
1887			Beasley, William Charles Trevor, M.A. (Cantab.), 10, Stockleigh-road, St. Leonards-on-Sea
1901			Beaven, Edwin Sloper, 5, Boreham-terrace, Warminster
1890	Trans.		Beck, Charles Ridgeway, F.I.C., 33, Werter-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, F.I.C., 35, South Beach-road, Ardrossan, N.B.
1906			Beckett, Richard Henry, Prof., B.Sc. (Lond.), The College, Nagpur, C.P., India
1901			Bedford, Frederick, B.Sc. (Lond.), 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, Peter Phillips, Prof., M.A., D.Sc. (Dun. and Lond.), B.Sc. (Vict.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1901			Bedwell, John Cardew, B.Sc. (Lond.), 65, High-street, Colchester
1905			Bees, William James, B.Sc. (Lond.), 43, Ash-grove, Hyde-park, Leeds
1900			Beesley, Frederick Arnold, B.Sc. (Lond.), 11, Park-place, Greenwich, S.E.
1872	Trans.		‖Beilby, George Thomas, F.R.S., F.I.C., 11, University-gardens, Glasgow
1891			Belbin, Tom St. John, Capt., Nortonthorpe Hall, near Huddersfield
1888			Belcher, John Hope, B.A., B.Sc. (Lond.), Municipal Technical Institute, Coventry
1891			‖Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester Alexander, B.A., M.B. (Dublin), F.I.C., Brooklands, Dawlish, S. Devon
1889			Bell, Edward Wightman, High Bridge, Spalding

Date of Election.		
1899		Bell, Hugh Poynter, B.A. (Cantab.), 3, Mincing-lane, E.C.
1865	Trans.	‖Bell, J. Carter, A.R.S.M., F.I.C., The Cliff, Higher Broughton, Manchester
1889		‖Bell, Percy Carter, Milburn, New Jersey, U.S.A.
1906		Bell, William Edward, Langholm, Yarborough-road, Lincoln
1904	Trans.	Bellars, Albert Ernest, B.A. (Cantab.), Magdalene College, Cambridge
1905		Belton, Francis George, Dean Vicarage, Kimbolton, Hunts.
1879		Bemrose, Joseph, F.I.C., 56, St. Famille-street, Montreal, Canada
1874		‖Bendix, David, F.I.C., Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1902		Benham, Keith Benham, B.Sc. (Lond.), F.I.C., Dean's Hill, Stafford
1881		‖Benjamin, Marcus, A.M. (Lafayette), Ph.B. (Columbia), Ph.D. (Nashville), Sc.D. (Pennsylvania), U.S. National Museum, Washington, D.C., U.S.A.
1904		Benn, Robert Haslam Durward, West Mount, Montreal, Canada
1900		Bennett, Alexander Hutcheon, c/o Messrs. Ogston & Moore, Messina, Sicily
1904		Bennett, Charles Thomas, B.Sc. (Lond.), A.I.C., 57, Larkhall-rise, Clapham, S.W.
1903		Bennett, Colin Noël, 3, St. Laurence-cottages, Caterham, Surrey.
1905		Bennett, Joseph, Windsor Printing Co., North Adams, Mass., U.S.A.
1904		Benson, Alick Cole, 29, Caroline-street, Eaton-square, S.W.
1892	Trans.	Bensusan, Arthur John, The Ouro Preto Gold Mines of Brazil, Ltd., Minas de Passagem, Ouro Preto, Brazil.
1904		Bentley, Walter Henry, B.A. (Oxon.), Secondary School, Central Polytechnic, Croydon
1896	Trans.	Bentley, William Henry, B.Sc. (Vict.), 6, Woodbine-terrace, Irlam, near Manchester
1890		Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1902	Trans.	Bergtheil, Cyril, Mosheri Factory, Mozufferpore Post Office, Tirhoot, India
1900		Beringer, Heinrich Rowland, 11, Dolcoath-road, Camborne, Cornwall
1882		‖Beringer, John Jacob, A.R.S.M., F.I.C., Basset-road, Camborne, Cornwall
1895		Berkeley, The Earl of, Foxcombe, Boar's Hill, Oxford
1890		‖Berncastle, Richard, 22, Aldridge-road-villas, Bayswater, W.
1893		Berridge, Douglas Jesse Penfold, M.A. (Oxon.), The Laboratory, Malvern College
1906		‖Berry, Arthur John, 5, University-gardens, Glasgow
1882		‖Berry, Edward Elhanan, F.I.C., 44, London Wall, E.C.

Date of Election.			
1899			Berry, Reginald Arthur, F.I.C., The West of Scotland Agricultural College, 6, Blythswood-square, Glasgow
1891			Berry, Thomas William, Education Office, Pentre, Rhondda, Glam.
1888	Proc.		Berry, William, 7, Hampton-park, Redland, Bristol
1883	Trans.	{C. 1898-1900}	‖Bevan, Edward John, F.I.C., 4, New-court, Lincoln's Inn, W.C.
1886			Bevan, John William, F.I.C., Risedale, St. James-crescent, Swansea
1903			Beveridge, Wilfred William Ogilvy, Major, R. Army Clothing Dep't., Grosvenor-road, S.W.
1897			Bhaduri, Jyoti Bhushan, M.A. (Calcutta), Principal Krishnaghur College, Krishnaghur, Dist. Nadia, Bengal, India
1903			Bhaduri, K., Prof., M.A. (Calcutta), Canning College, Lucknow, India
1903			Bibby, Charles Drake, 69, Queen's-road, Twickenham, Middlesex
1903			Bibby, Robert Gordon, New College, Oxford
1865			‖Bickerdike, William Edward, F.I.C., Bryers Croft, Wilpshire, near Blackburn
1902			‖Bickford, Harding, 46, Currie-street, Adelaide, South Australia
1875			Biggart, John William, F.I.C., Chemical Laboratory, 29, Cathcart-street, Greenock
1872			Biggs, Charles Henry Walker, 140, Salisbury-court, Fleet-street, E.C.
1881			Bingley, John, Northampton
1900			Binks, Frederick Nisbet, 42, Shortridge-terrace, Jesmond, Newcastle-on-Tyne
1894			Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898			Birkett, Walter, 23, Carline-road, Lincoln
1906			Birt, Roderick Harold Capper, B.A. (Oxon.), 54, Shooters Hill-road, Blackheath, S.E.
1879			‖Black, Andrew Heggie, St. John's, Wakefield, and Moor Lodge, Harrogate
1904			Black, John Wyclif, 20, Mardale-crescent, Edinburgh
1902			Black, Walter Geoffrey, A.I.C., The Limes, New-street, Braintree, Essex
1886			Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1899	Trans.		Blackman, Walter Lionel, Mostyn, Thornlaw-road, West Norwood, S.E.
1903			Blackshaw, George Neville, B.Sc. (Wales), Government School of Agriculture, Elsenburg, Mulder's Vlei, Cape Colony, S. Africa
1899			Blackshaw, John Frank, The Midland Dairy Institute, Kingston Fields, Derby
1902			Blair, Herbert, Harton Lodge, Harton, South Shields

Date of Election.		
1901		Blake, George Stanford, 8, The Vineyard, Richmond, Surrey
1890	Trans.	Blake, Robert Frederick, F.I.C., Chemical Department, Queen's College, Belfast
1890		Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne
1875		‖Blanshard, Charles Thomas, M.A. (Oxon.), The Grammar School, Bewdley
1906		Blatchley, Charles Frederick Polwhele, B.A. (Oxon.), Downside College, Bath
1892		Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1902		Blenkinsop, Richard, Garden Wharf, Church-road, Battersea, S.W.
1890		Blenkinsop, William Edmund Brandford, c/o Messrs. May and Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1903		Bliss, Henry James Wheeler, M.A. (Oxon.), c/o The Thames Varnish Co., Ltd., Island Wharf, Rainham, Essex
1899		Blofeld, Stuart, Rev., B.A., B.Sc. (Lond.), St. John's College, Battersea, S.W.
1896		‖Blood, Maurice, M.A. (Oxon.), 16, Alexandra-road, Kingston-on-Thames
1891		Bloomer, Frederick John, F.I.C., Penpont, Clydach, R.S.O., Glamorgan
1890	Trans.	Blount, Bertram, F.I.C., 76 and 78, York-street, Westminster, S.W.
1888		Bloxam, Arthur George, F.I.C., 105, Birkbeck Bank Chambers, Southampton-buildings, W.C.
1883	Trans.	‖Bloxam, William Popplewell, Prof., B.Sc. (Lond.), F.I.C., The Clothworkers Research Laboratory, The University, Leeds
1903		Bluman, Nicholas John, c/o Messrs. Bluman & Stern, Ltd., Plough-bridge, Deptford, S E.
1887		Blundstone, Edwin Richardson, B.A. (Cantab.), Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, Thomas Porter, M.A. (Oxon.), F.I.C., Tower-place, Shrewsbury
1896		Blyde, Joseph Edwin Alger, Merlin House, Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S. (Eng.), F.I.C., 26, Avenue-road, Regent's Park, N.W.
1892		Blyth, Meredith Wynter, B.A. (Cantab.), B.Sc. (Lond.), F.I.C., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, Arthur, Chemical Works, Stratford, E., and High-standing, Loughton, Essex
1902		Boardman, Ernest, B.Sc., (Vict.), 16, Hawthorne-road, Bolton.
1899		Boardman, Thomas Henry, B.A. (Cantab.), Christ's Hospital, West Horsham, Sussex

Date of Election.		
1878		Bodmer, Richard, F.I.C., Analytical Laboratory, 16, Southwark-street, S.E.
1899		Bogert, Marston Taylor, Prof., B.A. and Ph.B. (Columbia), Columbia University, New York City, U.S.A.
1906		Bogue, Thomas Going Stoney, 5, Kenilworth-square, Dublin
1899		Bolam, Robert Alfred, M.D. and B.Sc. (Dun.), M.R.C.P. (Lond.), 3, Savile-place, Newcastle-on-Tyne
1869	Trans.	‖Bolas, Thomas, F.I.C., 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, Edward Richards, 16, Flanchford-road, Ravenscourt Park, W.
1899		‖Bond, Alfred Ernest, Peterbrook, Warstock, near Birmingham
1883		Bond, Henry Charles, Rev., M.A. (Oxon.), Belle Vue Hall, Brighton
1893	Trans.	‖Bone, William Arthur, D.Sc. (Vict.), Ph.D., F.R.S., West House, Lidgett-park-road, Roundhay, Leeds
1893		Boone, William Thomas, B.Sc. (Lond.), 6, Sydenham-villas, Cheltenham
1884		Borland, William Dalrymple, F.I.C., Beacon Lodge, Green Street Green, near Dartford, Kent
1881		‖Borns, Henry, Ph.D. (Greifswald), 5, Sutton Court-road, Chiswick, W.
1895		‖Borradaile, Lancelot Alexander, M.A. (Cantab.), Selwyn College, Cambridge
1861		‖Bosanquet, Robert Holford Macdowall, M.A. (Oxon.), F.R.S., Castillo Zamora, Realijo Alto, Teneriffe, Canary Islands
1894	Proc.	Bose, Chuni Lal, Prof., 24, Mohendra Bose's-lane, Calcutta
1881		Bostock, George Henry, 20, Lake-view-avenue, Toronto, Canada
1881	Trans.	Bothamley, Charles Herbert, F.I.C., Tangle Wood, Southside, Weston-super-Mare
1887	Trans.	Bott, William Norman, Ph.D. (Heidelberg), 16, St. Helens-place, E.C.
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1869		‖Bottomley, James Thomson, M.A., D.Sc., Hon. LL.D., (Glas.), F.R.S., 13, University-gardens, Glasgow
1886		Bottomley, William Beecroft, Prof., M.A. (Cantab.), Ph.D., 35, Downside crescent, Hampstead, N.W.
1894		Boul, William Good, M.A. and LL.D. (Dub.), D.C.L. (Dun.), Tideswell Grammar School, near Buxton
1901		Bousfield, Edward George Paul, The Saxon Engineering Co., Ltd., Fenton, Stoke-on-Trent
1905	Trans.	Bousfield, William Robert, M.A. (Cantab.), K.C., St. Swithin's, Hendon
1891		Bovell, John Redman, Dodd's Botanical and Experimental Station, Barbados, West Indies

Date of Election.		
1865		‖Bowdler, Arthur Clegg, F.I.C., 20, Bank-terrace, Wellington-street, Blackburn
1903		Bowen, William, F.I.C., c/o R. R. I. Fowler, Esq. (Rural Route 1), Fresno Co., California, U.S.A.
1888		Bower, Frank, c/o Messrs. Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, F.I.C., Messrs. Bowes and Sims, 40, Radford-street, Blackley, Manchester
1906		Bowis, William John, Ph.D. (Zürich), 97, North-road, West Bridgford, Notts
1899		Bowles, Bertram Hennessey, Overdale, Eastwood-road, South Woodford, N.E.
1896		Bowley, Joseph John, 64, Redcliffe-gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, 4, Albert-square, Manchester
1862		Bowman, Frederic Hungerford, F.I.C., Assoc. Inst. C.E. and M.E., 4, Albert-square, Manchester
1896		‖Bowman, Herbert Lister, M.A. (Oxon.), Greenham Common, Newbury, Berks
1894	Trans.	Boyd, David Runciman, Prof., D.Sc. (Glas.), Ph.D. (Heidelberg), F.I.C., The Hartley University College, Southampton
1901		Boyers, Henry, 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1903		Bradbury, Samuel, Ferncliff, Milton-grove, Glebelands-road, Ashton-on-Mersey, Cheshire.
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Aberfeldy, Southwick, near Brighton
1876		‖Bradley, Nathaniel, Sunnyside, College-road, Whalley Range, Manchester
1888		Bradshaw, Charles, 169, Spring Vale-road, Sheffield
1906		Braid, Arthur Forbes, 29, Hampton-road, Forest Gate, E.
1894	Trans.	Brame, John Samuel Strafford, Royal Naval College, Greenwich, S.E.
1903		Branch, George Thomas, c/o Messrs. Strachan & Co., Chemists, Umtali, Rhodesia, South Africa
1904		Brand, Herbert Frank, M.A. (Lond.), 13, Clifton-road, Brockley, S.E.
1882		Branson, Frederic Woodward, F.I.C., 14, Commercial-street, and Wynneholme, Far Headingley, Leeds
1882	Trans.	Brauner, Bohuslav, Prof., Ph.D. (Prague), Hon. D.Sc. (Manc.), New Chemical Laboratory, Bohemian University, Prague, VI., Bohemia
1896		Bray, Daniel, 13, Muslin Hall, New Mill, near Huddersfield
1905		‖Brettell-Vaughan, Edward Shipley Hewitt Edwards, 15, Queen-street, Cheapside, E.C.

Date of Election.			
1883			Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901			Bridges, Joseph Samuel, B.Sc. (Lond.), 45, Thistlethwaite-road, Clapton, N.E.
1904	Trans.		Bridgett, Robert Currie, M.A., B.Sc. (St. Andrews), 32, Queen Anne-street, Dunfermline, Fifeshire, N.B.
1897			Brierley, James, 33 and 35, French-street, Southampton
1890	Trans.		Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston
1898			Brierley, Joseph, B.Sc. (Vict.), Ashton-road, Failsworth, Manchester
1893	Proc.		Briggs, John Frederick, 2, Frankfort-road, Herne Hill, S.E.
1906			Briggs, Richard Victor, Research Station, Sirseah, Mozufferpore P.O., T.S. Railway, Bengal, India
1905	Trans.		Briggs, Samuel Henry Clifford, B.Sc. (Vict.), Greenbank, Cleckheaton, Yorks.
1883			‖Briggs, Thomas Lynton, F.I.C., 188, Central-avenue, Flushing, L.I., U.S.A.
1884			‖Briggs, William, LL.D., D.C.L., M.A., B.Sc., Burlington House, Cambridge
1902			Brincker, John Augustus Herman, B.A., M.B. and B.C. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), A.I.C., 57, Great Ormond-street, W.C.
1898	Trans.		Brittain, Charles Edward, B.Sc. (Vict.), Grammar School, Normanton, Yorks.
1900			Britten, Frank Curzon, B.A. (Oxon.), Odiham School, Odiham, Hants.
1889			Broadbent, Harry, F.I.C., 187, Hyde Park-road, Leeds
1879			‖Broadbent, John James, F.I.C., 14, Cross-street, Exchange, Manchester
1883			Brock, John, J.P., F.I.C., Gwern-Tyno, Colwyn Bay, N. Wales
1893			‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth
1884			Brodie, Sir Benjamin Vincent Sellon, Bart., M.A. (Oxon.), F.S.A., Brockham Warren, Betchworth, R.S.O., Surrey
1898			Brooke, Arthur, M.A. (Cantab.), The Grammar School, Caistor, Lincs.
1900			Brooke, Charles Berjen, Colne House, Brantham, near Manningtree, Essex
1900			Brooke, John Richard, F.I.C., The Government Laboratory, Singapore, Straits Settlements
1886	Trans.		‖Brothers, Horace Edward, B.Sc. (Lond.), F.I.C., Annsville, Glenburn-park, Belfast
1884		C. 1895-8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, Prof., M.Sc. (Birm.), F.I.C., West Heath House, Northfield, Worcs.

Date of Election.			
1867	Trans.	C.1872-4, V.P.81-4, 90-1. P. 91-3	Brown, Alexander Crum, Prof., M.A., M.D. (Edin.), D.Sc. (Lond.), LL.D. (Aberdeen), F.R.S., F.I.C., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, F.I.C., 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, c/o Messrs. W. Ropes and Co., St. Petersburg, Russia
1873	Trans.	C. 1881-3	‖Brown, Frederic Douglas, Prof., B.Sc. (Lond.), University College, Auckland, New Zealand
1884			Brown, Frederic William, Ingleside, 39, Loveday-road, West Ealing, W.
1892			Brown, George Fitz-, A.R.S.M., F.I.C., The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, Gerald Noël, 20, Cullum-street, E.C.
1880			Brown, Henry, F.I.C., Benskin's Brewery, Watford, Herts.
1871	Trans.	C. 1883-7 V.P.91-7, 1904- T.1903-04.	†Brown, Horace Tabberer, LL.D. (Edin.), F.R.S., F.I.C., 52, Nevern-square, Kensington, S.W.
1867	Trans.		‖Brown, James Campbell, Prof., D.Sc. (Lond.), F.I.C., 8, Abercromby-square, Liverpool
1905			Brown, John Coggin, B.Sc. (Dun.), H.M. Geological Survey, Calcutta, India
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1892			Brown, Reginald Busby, c/o The Badische Co., Ltd., 2, Samuel Ogden-street, Manchester
1884			Brown, William George, Prof., Ph.D. (N. Carolina), B.S. (Virginia), University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, Charles Edward, B.Sc. (Lond.), Christ's Hospital, West Horsham, Sussex
1893			Browne, Frank, Government Civil Hospital, Hong Kong, China
1873			Brownen, George, Grove-road-east, Avon-park, Christchurch
1899	Trans.		Browning, Kendall Colin, Prof., M.A. (Cantab.), Medical College, Colombo, Ceylon
1890			Brownsword, Frank, M.Sc. (Vict.), F.I.C., Bryn Derwen, Old Colwyn, N. Wales
1902			Bruce, Alexander, B.Sc., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1894	Trans.		Bruce, James, B.Sc. (Lond.), F.I.C., The Technical College, Huddersfield
1895			Bruckmann, Gustav Theodore, B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1903			Brühl, Paul, Civil Engineering College, Sibpur, near Calcutta, India

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† Longstaff Medallist, 1894.

Date of Election.		
1899	Trans.	‖Brünnich, Johannes Christian, F.I.C., Department of Agriculture, Brisbane, Queensland
1893	Trans.	‖Brunton, John Dixon, c/o W. O. Richardson, Esq., Neviles-court, Cambridge
1902		Bryant, Vernon Seymour, B.A. (Cantab.), 80, Beeches-road, West Bromwich
1877	Trans.	‖Buch, Carl von, M.A. (Oxon.), F.I.C., 36, Great Marylebone-street, W.
1877	Trans.	Buchanan, John Young, M.A. (Cantab.), F.R.S., F.I.C., 26, Norfolk-street, Park-lane, W.
1876		‖Buckmaster, Charles Alexander, M.A. (Oxon.), F.I.C., 16, Heathfield-road, Mill Hill Park, Acton, W.
1902		Bucknell, Edwin Thomas Holman, 19, Reservoir-road, Edgbaston, Birmingham
1903		Buggé, Erasmus Robert, 296, Burdett-road, Stepney, E.
1898	Trans.	Bull, Benjamin Samuel, M.A., B.Sc. (Ch. Ch. N.Z.), Ph.D. (Munich), F.I.C., Greylands, 104, Humber-road, Blackheath, S.E.
1901		Bult, Herbert John, 18, Billiter-street, E.C.
1890		Bunting, Henry Herbert, c/o Peruvian Corporation, Ltd., Lima, Peru
1896		Burbridge, James Kerry, F.I.C., The Orchard, Philip-lane, Tottenham, N.
1891		Burford, Samuel Francis, Beechworth, Stoneygate-road, Leicester
1898		Burge, Charles Henry, F.I.C., Iddesleigh, Crescent-road, Kingston Hill, S.W.
1894	Trans.	Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.
1901		Burgess, Percival James, M.A. (Cantab.), Government Analyst, Singapore, Straits Settlements
1884		Burgess, William Thomas, F.I.C., 20, Priory-road, Bedford Park, W.
1903		Burghard, William Godsell, 180, High Holborn, W.C.
1884		‖Burland, Jeffrey Hale, 342, Sherbrooke street, Montreal, Canada
1897		Burland, Richard Oxley, J.P., Poolstock House, Wigan
1901		‖Burnett, Theodore Ridley, B.Sc. (Vict.), Ph.D. (Basel), The Grammar School, Kirkby Lonsdale, Westmoreland.
1893		Burnham, John Charles, B.Sc. (Vict.), F.I.C., Cordite Factory, Wellington, Nilgiri Hills, India
1882	Trans.	Burrell, Benjamin Arthur, F.I.C., 8, Springfield Mount, Leeds
1902	Trans.	Burrows, Harry, Ph.D. (Heidelberg), A.R.C.S., F.I.C., The Green, Southgate, N.
1901	Trans.	Burrows, Merrick William, M.Sc. (Vict.), Dunkirk, Devizes

Date of Election.		
1905	Trans.	Burt, Bryce Chudleigh, B.Sc. (Lond.), Government Laboratory, Port of Spain, Trinidad, West Indies
1891		Burton, William, Clifton Junction, near Manchester
1901		Burton, William, B.A. (Cantab.), B.Sc. (Wales), 47, Humberstone road, Cambridge
1903		Bury, Ernest, M.Sc. (Vict.), Brackley Coke Works, Little Hulton, near Bolton, Lancs.
1894		Bush, William, School of Science and Art, Free Library, Newport, Mon.
1904		Busher, Thomas Story, B.A. (Oxon.), Park Villa, Kendal
1890		Butcher, William James, B.Sc. (Lond.), Queen Elizabeth Grammar School, Ashbourne, Derbyshire
1895		Butler, David Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston, Birmingham
1894		Buttemer, Robert William, St. Mary's, Godalming, Surrey
1875		Butterfield, John Cope, F.I.C., 79, Endlesham-road, Balham, S.W.
1892		Butterfield, William John Atkinson, M.A. (Oxon.), F.I.C., 66, Victoria-street, S.W.
1902		Buxy, Tarit Kanti, Prof., Government College, Jubbulpur, C.P., India
1888		Byrn, George Alexander, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1903		Bywaters, Hubert William, Ph.D. (Würzburg), A.R.C.S., F.I.C., 11, King-street, Regent-street, W.
1903		Cadman, William Henry, B.Sc. (Wales), Ibrahimieh, Alexandria, Egypt.
1893		‖Cahill, Robert Saunderson, Sunnyside, Heckmondwike
1894	Trans.	‖Cain, John Cannell, D.Sc. (Vict. and Tübingen), 28, Pembury-road, Clapton, N.E.
1906		Calam, Harold, B.Sc. (Vict.), A.I.C., 71, Cemetery-road, Beeston-hill, Leeds
1904		Caldecott, Lawrence, 56, Stanley-street, Fairfield, Liverpool
1898	Proc.	Caldecott, William Arthur, B.A. (Cape of Good Hope), Box 67, Johannesburg, Transvaal, South Africa
1891		‖Calder, William Alexander Skeen, Ormidale, Little Moor Hill, Smethwick, near Birmingham
1904		Caldwell, Robert John, B.Sc. (Lond.), 40, Salehurst-road, Crofton Park, S.E.
1906		Caldwell, William, M.A. (R.U.I.), Physiological Department, Trinity College, Dublin
1884		Caley, Edward James, Chapel Field Works, Norwich
1903	Trans.	Calvert, Harry Thornton, Ph.D. (Leipzig), B.Sc. (Vict.), F.I.C., West Riding of Yorkshire Rivers Board, Wakefield, Yorks.

Date of Election.			
1900			Calvert, Sidney, A.M. (Harvard), B.Sc. (McGill Univ.), State University, Columbia, Missouri, U.S.A.
1894			Cameron, Alexander, Whitcher-place, Rochester-road, Camden Town, N.W.
1893			Cameron, James, Ingleby, 70, Old Chester-road, Wood Hey, Rock Ferry, Birkenhead
1875			Cameron, John Macdonald, F.I.C., Castle Hill, Tain, N.B.
1892			Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burma
1905			Campbell, Eric William, 49, Brougham Street, Greenock, N.B.
1905			Campbell, James Haig, Argyle, Carfin-road, Motherwell, N.B.
1888	Trans.		Campbell, John Morrow, B.Sc., Blenheim-gardens, Wallington, Surrey
1903			Campbell, Thomas, 38, Eastbourne-street, Liverpool
1898			Campion, Alfred, F.I.C., 144, Wellington-street, Glasgow
1896			Candy, Hugh Charles Herbert, B.A., B.Sc. (Lond.), F.I.C., The College, London Hospital, E.
1884			Cannon, Matthew, 25, Stormont-road, Clapham Common, S.W.
1898			Cannon, Matthew James, 16 and 17, Devonshire-square, Bishopsgate-street, E.C.
1900			Cantin, Angélo, Prof., Royal College of Mauritius, Vacoas, Mauritius
1888			Carey, Alfred Edward, M.Inst.C.E., 3, Victoria-street, S.W.
1892	Trans.		Carey, Arthur, B.Sc. (Vict.), 1, Grassendale-road, Grassendale, near Liverpool
1902			Carmichael, Thomas Burnell, Parton, Whitehaven
1889			Carmody, Patrick, Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.		‖Carpenter, Henry Cort Harold, M.A. (Oxon.), Ph.D. (Leipzig), National Physical Laboratory, Bushy House, Teddington, S.W.
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895	Trans.		Carr, Francis Howard, F.I.C., Kelvin, Church-avenue, Sidcup, Kent
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks.
1902			Carrodus, Fred, Glen Fern Tower, Lansdowne-road, Wimbledon, S.W.
1882			‖Carruthers, Robert, Kirkbank House, Dumfries
1893			Carswell, Thomas Retson, 50, Sandmere-road, Clapham, S.W.
1864		C. 1878-82, 84-8	‖Carteighe, Michael, F.I.C., 180, New Bond-street, W.
1901	Trans.		Carter, William, Sewage Works, Bury
1867			‖Carulla, Facundo Joaquin Ramon, Argyll-terrace, 84, Rose-hill-street, Derby

Date of Election.			
1895			Case, Thomas Bennett, B.A. (Oxon), 108, James's-street, Dublin
1879			‖Cassal, Charles Edward, Lieut.-Col., F.I.C., Town Hall, Kensington, W.
1903			Castell-Evans, John, F.I.C., Carn Dochan, 4, Ranelagh-gardens, Ilford, E.
1894			Catherall, Ezra, Heathmere, Albany-road, Harborne, Birmingham
1903			‖Caudwell, Ben, B.A. (Lond.), 28, Wigfull-road, Sheffield
1898	Trans.		Caven, Robert Martin, D.Sc. (Lond.), F.I.C., University College, Nottingham
1902			Challen, Matthew Bradbury, School of Mines, Daylesford, Victoria, Australia
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, Arthur Garratt, 3, Market-place, Rugby
1906			Chamberlain, Percy Garratt M.A. (Cantab.), 3, Market-place, Rugby
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			‖Chance, Alexander Macomb, c/o Messrs. Chance and Hunt, Ltd., Chemical and Cement Works, Oldbury
1902			‖Chance, Kenneth Macomb, B.A. (Cantab.), The Bath Club, Dover-street, W.
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1872			Chandler, William H., Prof., Chem. Dept., Lehigh University, South Bethlehem, Pa., U.S.A.
1889			‖Chaplin, Edward Mitchell, Ph.D., Public Analyst's Office, Wakefield
1886	Trans		Chapman, Alfred Chaston, F.I.C., 8, Duke-street, Aldgate, E.C.
1895			Chapman, Arthur Jenner, F.I.C., Baronsmere, Stanhope-avenue, Church End, Finchley, N.
1899	Trans.		Chapman, David Leonard, B.A. (Oxon.), 10, Parsonage-road, Withington, Manchester
1900	Trans.		Chapman, Edgar Marsh, F.I.C., Cairnsmore, Manor-road, Scarborough
1868			Chapman, Edward, Hill End, Mottram, Manchester
1891			Charles, Rhys Pendrill, F.I.C., Plâs Newydd, Neath
1900			Chater, Arthur Brand, 65, Queen-street, Brisbane, Queensland
1894	Trans.	C. 1900-03	Chattaway, Frederick Daniel, M.A. (Oxon.), D.Sc. (Lond.), Ph.D. (Munich), Hon. B.Sc. (Birm.), F.I.C., Longfield, Kenton-road, Harrow
1905			Chatterji, Hem Chandra, Prof., B.A. (Allahabad), Christ Church College, Cawnpore, India
1895			Cheadle, Walter William M.A. (Oxon.), 36, London-road, Grays, Essex

Date of Election.			
1899			Cheater, Thomas John, B.Sc. (Lond.), 3, The Mansions, Star and Garter, Putney, S.W.
1900			Cheeseright, John Henry, B.Sc. (Lond.), 7, Claremont-place, Gateshead-on-Tyne
1887			Chenhall, James Warne, M.Inst.C.E., Dart-villas, Totnes, Devon
1878			Cheshire, Horace Fabian, B.Sc. Lond.), F.I.C., Woodside Shornden, St. Leonards-on-Sea
1882			‖Chester, Edward D.
1897	Trans.		Chikashigé, Masumi, D.Sc. (Kyoto), Kreugbergweg, 15, Göttingen, Germany
1897			Cholerton, Alfred Foster, c/o Messrs. A. de St. Dalmas & Co., 40½, Belgrave-gate, Leicester
1891	Trans.		‖Chorley, John Christmas, Bewsey, Oxford-road, Birkdale, Lancs.
1885			Christopher, Robert George, Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William James, F.I.C., 7, West George-street, Glasgow; and Shawfield Works, Rutherglen, near Glasgow
1906			Chrystall, Edwin Rodney, Forest Villa, Prince's-road, Buckhurst Hill, Essex
1856	Trans.	{C. 1876-80, 87-90}	‖Church, Arthur Herbert, Prof., M.A., D.Sc. (Oxon.), F.R.S., F.I.C., Shelsley, Kew, Surrey
1903			Clacher, William, c/o Mrs. Cuthbert, 33, Kelly-street, Greenbank, Greenock, N.B.
1888	Trans.		Claisen, Ludwig, Geh. Rath Prof., Ph.D. (Bonn), Bleibtreustrasse, 38 and 39 II, Berlin, W., Germany
1901	Trans.		Clark, Ernest, B.Sc. (Lond.), Royal Technical Institute, Salford, and 16, Havelock-street, Sheffield
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1905			Clark, Friend Ebenezer, B.Sc. (Virg.), Ph.D. (Johns Hopkins Univ.), The Central University of Kentucky, Dannville, Ky., U.S.A.
1876	Trans.		Clark, John, Ph.D. (Göttingen), F.I.C., 138, Bath-street, Glasgow
1904			Clark, Peter Skinner, M.B. and C.M. (Glas.), Westpark, Cradock, Eastern Province, Cape Colony, South Africa
1905			Clark, Thomas Walter Firth, The Laboratory, Johnson-street, Mile End, E.
1906			Clarke, Reginald William Lane, A.I.C., 15, Torridon-road, Hither Green, S.E.
1905			Clarkson, George Douglas, Ash House, Mirfield, Yorks.
1902			Claudet, Arthur Crozier, A R.S.M., F.I.C., 27, Daleham-gardens, Hampstead, N.W.
1882	Proc.		Clayton, Edwy Godwin, F.I.C., 32, Holborn-viaduct, E.C.
1904			Clayton, Ellis, Municipal Technical Institute, Belfast

Date of Election.			
1893			Clayton, George, Northern College of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, 3 and 5, Concert-street, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A. (Oxon.), F.I.C., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, William, Sewage Outfall Works, Wolverhampton
1878			Cloud, Thomas Charles, A.R.S.M., F.I.C., Coronation House, 4, Lloyds-avenue, Fenchurch-street, E.C.
1902			Clough, William Thomas, A.R.C.S., Chelladene, St. Margaret's-road, Wanstead Park, Essex
1869	Trans.	C. 1885-90, 99-03	‖Clowes, Frank, Prof., D.Sc. (Lond.), F.I.C., The Grange, College-road, Dulwich, S.E., and 40, Craven-street, Charing Cross, W.C.
1902			Clowes, George Henry Alexander, Ph.D. (Göttingen), Gratwick Research Laboratory, University of Buffalo, U.S.A.
1897			Clutterbuck, Medwin Caspar, B.Sc. (Lond.), Ph.D. (Strassburg), 61, Beaconsfield-villas, Brighton
1905	Trans.		Coates, Joseph Edward, B.Sc. (Wales), Sunny Side, Oakamoor, Stoke-on-Trent
1887			Coates, William Henry, M.A., M.B. (Dun.), M.R.C.S., L.R.C.P. and L.S.A. (Lond.), 7, Albion-street, Hull
1896			Cobb, Walter William, M.A. (Oxon.), Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A. (Cantab.), Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D. (Berlin), 115-119, W. 68th-street, New York, U.S.A.
1880			‖Cockburn, Arthur Cecil, The Grange, Otley, near Ipswich
1895	Trans.		Cockburn, George Bertram, B.A. and B.Sc. (Oxon.), Lingdale Lodge, Birkenhead
1901			Cockburn, Thomas Kennedy, 148, Woodstock-avenue, Shawlands, Glasgow
1892			Cockerill, Thomas, Bolton, Colpetty-road, Colombo, Ceylon
1893			Cocking, Allan Thomas, Carhampton House, Four Oaks, Sutton Coldfield
1888			Cocking, Lewis Smith, Rashcliffe Dyewood Mills, Huddersfield
1902			Cockle, Charles, 44, Fairfield-road, Winchester
1901			Coddington, Eustace, M.A. (Cantab.), 131, St. James's-road, Upper Tooting, S.W.
1903			Codling, Arthur John, 5, Tavistock-square, W.C.
1881			‖Coffin, Walter Harris, The National Liberal Club, Whitehall-place, S.W.
1885	Trans.		Cohen, Julius Berend, Prof., Ph.D. (Munich), B.Sc. (Vict.), The University, Leeds

Date of Election.			
1901			‖Cohen, Robert Waley, B.A. (Cantab.), 15, Hyde-park-square, W.
1900			Cole, Oscar Joseph, B.A. (Lond.), Park-road, Wivenhoe, Essex
1891	Trans.		Colefax, Arthur, M.A. (Oxon.), Ph.D. (Strassburg), 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, F.I.C., S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Collenette, Adolphus, Brooklyn, Fort-road, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcs.
1905	Trans.		Colles, William Morris, jun., B.Sc. (Lond.), 16, Birchington-road, West Hampstead, N.W.
1881			Collett, John Marton, Hillfield, Gloucester
1885	Trans.	C. 1889-94,1900-1	‖Collie, John Norman, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc. (Lond.), F.I.C., 73, Fountain-road, Edgbaston, Birmingham
1892			‖Collins, Hugh Brown, B.Sc. (Glas.), 42, Crossloan-road, Glasgow
1890			‖Collins, Sydney Hoare, M.Sc. (Dun.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1888			Collins, Walter Hepworth, c/o Messrs. Edward Wihl & Co., 17, Nicholas-street, Manchester
1905			Collitt, Bernard, 79, Eastbourne-terrace, Gainsborough
1887	Trans.		‖Colman, Harold Govett, Ph.D. (Würzburg), M.Sc. (Vict.), F.I.C., Elmside, Worcester Park, Surrey
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900			Comber, Albert Walter, F.I.C., Suramangalam, Salem District, S. India
1892			‖Comyns, Frank, M.A. (Oxon.), Brynm, Craven-street, Newbury, Berks.
1899			Connah, James, B.Sc. (Lond.), F.I.C., The Laboratory, Custom House, E.C.
1875			Connor, Charles Cunningham, B.A. (Q.U.I.), 4, Queen's Elms, Belfast.
1883			‖Conrad, Edwin Charles, 101, Leadenhall-street, E.C.
1906			Conyngham, William Boulton, Sandon, Ballsbridge, Co. Dublin
1902			Cook, Arthur James, 167, Richmond-road, Hackney, N.E.
1875	Trans.		‖Cook, Ernest Henry, D.Sc. (Lond.), F.I.C., The Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895			Cook, Herbert William, B.Sc. (Lond.), The Technical Institute, Tunbridge Wells, Kent
1890			Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888			Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889			Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.

Date of Election.		
1898		‖Cooper, Albert John Bullen, Grimston Lawn, Haven-green Ealing, W.
1892		Cooper, Arthur James, B.A. (Dub.), B.Sc. (Lond.) F.I.C., Brewood School, Staffs.
1888		Cooper, Astley, Clifford, near Boston Spa, R.S.O., Yorks.
1906		Cooper, Herbert Reginald, Redington, Northwood, R.S.O., Middlesex
1904		Cooper, Jabez Horace, B.A. (Oxon.), 13, Victoria-terrace, Exeter
1898		Cooper, John Burdon, M.D., B.S., B.Sc. (Dun.), Glenartney, Poole-road, Bournemouth
1900		Cooper, William Francis, B.A. (Cantab.), 7, Grosvenor-road, Watford
1891		Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897		Cooper, William Ranson, M.A., B.Sc. (R.U.I.), A.C.G.I., A.I.C., 113, Tulse Hill, S.W.
1894	Proc.	Coote, Arthur Herbert, Garwood, 36, Humber-road, Blackheath, S.E.
1899	Trans.	Cope, Frank, Swindon Villa, Dewsbury
1890		‖Coppock, John Bridgeford, B.Sc. (Lond.), F.I.C., The Technical School, Kendal
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts.
1901	Trans.	Cormack, William, c/o Messrs. G. Nelson Dale & Co., Emscote Mills, Warwick
1888		‖Cornish, Vaughan, D.Sc. (Vict.), 157, Westbourne-grove, W.
1890		Corrie, David, Nobel's Explosives Company, West Quarter Factory, Polmont Station, N.B.
1893	Trans.	Coste, John Henry, F.I.C., 54, Alconbury-road, Upper Clapton N.E.
1892		‖Couldrey, Henry, His Majesty's Mint, Bombay, India
1905		Coupe, Miles, 46, Millarbarn-lane, Waterfoot, near Manchester
1906		Courtauld, Stephen Lewis, B.A. (Cantab.), Bocking-place Braintree, Essex.
1900		Courtman, Ernest Owen, Denford House, Atkins-road, Clapham Park, S.W.
1903		‖Cousins, Francis George, 16, Old Elvet, Durham
1901	Trans.	Cousins, Herbert Henry, M.A. (Oxon.), Government Laboratory, Kingston, Jamaica
1885		Cousins, William James, F.I.C., 17, Temple-chambers, Temple-avenue, E.C.
1886	Trans.	‖Coutts, Francis James Henderson, M.D., B.Ch., D.P.H. (Vict.), 264, Hornby-road, Blackpool
1898		Cowburn, Arthur William, 29, Princess-street, Manchester

Date of Election.			
1882			‖Cowie, Thomas Rennie, Garnkirk House, Garnkirk, N.B.
1905			Cowie, William Beaverly, 26, East Claremont-street, Edinburgh
1898			Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873			Cownley, Alfred John, F.I.C., 225, Barry-road, Dulwich, S.E.
1905			Cowman, Douglas Henry Bellars, The Grammar School, Galway, Ireland
1904			Cowper, Alfred Denys, 121, Castellain-mansions, Maida Vale, W.
1888			Cowper, Joseph, 50, King-street, Penrith
1886			Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898			Cox, Frederick Hudson-, F.I.C., 46, St. James'-road, Brixton, S.W.
1873			Cox, Samuel Herbert, 13, St. Helen's-place, London, E.C.
1903			Coyle, Benjamin Claxton, City Laboratory, 17, Castle-street, Dublin
1904			Crabbe, William, B.Sc. (Lond.), 19, Duppas-hill-terrace, Croydon.
1901			Crabtree, Arthur, 148, Westgate-road, Newcastle-on-Tyne
1870	Trans.		Crafts, James Mason, Prof., 59, Marlborough-street, Boston, Mass., U.S.A.
1892	Trans.		Craig, Andrew William, College of Pharmacy, 360, Swanston-street, Melbourne, Victoria
1875			‖Crampton, George.
1897			Cranfield, William, The Higher Grade Board School, Halifax
1897			Creasey, Clarence Hamilton, Beechwood, Thorn-park-road, Plymouth
1887			‖Cribb, Cecil Howard, B.Sc. (Lond.), F.I.C., 136, Shaftesbury-avenue, W.
1878			‖Criper, William Risdon, A.R.S.M., F.I.C., Chemical Works, Konnagar, Calcutta
1895			Crocker, Charles, Norman House, St. Peter's-road, Cockett, Swansea
1902	Trans.		Crocker, James Codrington, B.A. (Cantab.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1901			Crocker, Walter Stevens, 39, Arnold-street, Princes Park, Liverpool
1897	Trans.		Crofts, James Murray, M.A. (Cantab.), B.Sc. (Lond.), The College, Barnato Park, Johannesburg, South Africa
1886	Trans.		‖Crompton, Holland, Binfield, Chester-road, Northwood, Middlesex
1902			Crookes, Henry, 109, Ladbroke-grove, Notting Hill, W.
1901	Trans.		Crookes, Samuel Irwin, Richmond, 113, Heythorp-street, Southfields, S.W.
1857	Trans.	C. 1866-70 V.P. 76-9, 85-7 P. 87-9	‖Crookes, Sir William, D.Sc. (Oxon., Ireland, Cape of Good Hope), F.R.S., F.I.C., 7, Kensington Park-gardens, W., and Athenæum Club, Pall Mall, S.W.

Date of Election.			
1879	Trans.	C. 1890-1 93-5	‖Cross, Charles Frederick, B.Sc. (Lond.), F.I.C., 4, New-court, Lincoln's Inn, W.C.
1890	Trans.	C. 1901-2 S. 1905-	‖Crossley, Arthur William, Prof., D.Sc. (Vict.), Ph.D. (Würzburg), F.I.C., Pharmaceutical Society, 17, Bloomsbury-square, W.C., and 10, Crediton-road, West Hampstead, N.W.
1901			Crossley, Frank, Duchy Bank, Seedley-road, Pendleton, Manchester
1896			Crossman, Charles Matthew, B.Sc. (Lond.), Cannon House, Watford, Herts.
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1899			Crouch, William Samuel, 265, Glossop-road, Sheffield
1880	Trans.		Crow, John Kent, D.Sc. (Lond.), F.I.C., Tressillian, Ulundi-road, Blackheath, S.E.
1887			‖Crowther, Horace Woodward, F.I.C., The Beeches, West Bromwich
1895			Croysdale, John, Whitley Bridge, R.S.O., Yorks.
1884			Crumbie, William Drake, 146, Washington-street, East Orange, New Jersey, U.S.A.
1887	Trans.		Cundall, James Tudor, B.Sc. (Lond.), F.I.C., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1904			Cunningham, James Edward, 21, Blenheim-gardens, Willesden Green, N.W.
1899	Trans.		Cunnington, Alfred Valentine, B.A. (Cantab.), c/o Messrs. Brunner, Mond & Co., Northwich
1875			Curphey, William Salvador, F.I.C., 7, Derby-crescent, Kelvinside, Glasgow
1900			Cussons, John, B.Sc. (Vict.), Public School, Villiersdorp, Cape Colony, South Africa
1881			‖Custance, John D., Prof., Adelaide, South Australia
1895			Cuthbertson, Lionel Mould Gurney, 89, Lordship Park, N.
1894			Dains, Herbert Henry, F.I.C., 27, Inderwick-road, Stroud Green, N.
1901	Trans.		Dakin, Henry Drysdale, D.Sc. (Vict.), F.I.C., 819, Madison-avenue, New York, U.S.A.
1905			Dallman, Arthur Augustine, Lyndhurst, Prospect-vale, Liverpool
1904			Dalton, William Herbert, 85, Hayter-road, Brixton Hill, S.W.
1901	Trans.		Daniel, Gilbert Howard, B.Sc. (Lond.), 25, Church-walk, Ulverston
1897			Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal
1887			Daniell, Louis Charles, Royal Standard Brewery, Tamworth, N.S.W.
1902			Daniels, James Ward, Westwood, Medomsley, R.S.O., Durham

Date of Election.		
1850		‖Danson, Joseph.
1892	Trans.	Darbishire, Francis Vernon, B.A. (Oxon.), Ph.D. (Leipzig), South Eastern Agricultural College, Wye, Kent
1852		Darby, Stephen, F.I.C., Cookham Dean, Berks.
1899		Darling, Charles Robert, A.R.C.S.I., A.I.C., Bryniach, Brent-road, Plumstead, Kent
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	‖Darling, William Howarth, F.I.C., 26, Dover-street, Manchester
1893		Davey, George, 31, Carlton-vale, Maida-vale, W.
1875		‖Davey, G. William, 23, Melbourne-road, East Ham, E.
1905		Davey, Joseph Morgan, Shelone House, Briton Ferry, Glam.
1897		Davidge, Henry Norris, 23, Rydal-road, Streatham, S.W.
1900		Davidson, Alexander, jun., F.I.C., 8, Traquair-park, Corstorphine, S.O., Midlothian
1906		Davidson, Charles, 328, Golfhill-drive, Dennistoun, Glasgow
1901		Davidson, John Howard, B.Sc. (Vict.), Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell-green, Halifax
1899	Trans.	Davidson, William Brown, M.A., D.Sc. (Aberdeen), Ph.D. (Würzburg), F.I.C., Saltley Gas Works, Birmingham
1866	Trans.	‖Davies, Arthur Ellson, Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, F.I.C., The Laboratory, 28, Chapel-street, Liverpool
1905		Davies, John Llewelyn, B.A. (Cantab.), 8, Rugby-road, Neath
1896		Davies, Llewellyn John, Bute-chambers, Bute-road, Cardiff
1894		Davies, Samuel Henry, B.Sc. (Vict.), Rowntree's Cocoa Works, York
1900		Davis, Arthur Charles, 2, Downing-grove, Cambridge
1902		Davis, Charles Benson, c/o Dr. Francis Wyatt, S.W.-corner, 23rd-street, and 9th-avenue, New York, U.S.A.
1901		Davis, Francis, Forest Villa, Ovenden, Halifax, Yorks.
1902		Davis, Frederick, B.Sc. (Vict.), Hazel House, Hayfield, near Stockport
1902		Davis, Henry Wilson, F.I.C., Farleigh, Crescent-road, Kingston Hill, S.W.
1857		‖Davis, J. Frederick, c/o J. Lewis, Esq., Government Laboratory, Parliament-street, Cape Town, South Africa
1872	Trans.	‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876		Davis, Thomas Sebastian, 199, South Lambeth-road, S.W.
1897	Trans.	Davis, William Alfred, B.Sc. (Lond.), Central Technical College, South Kensington, S.W.
1876		‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol

Date of Election.			
1900			Davison, Thomas Cuthbert, Bower-hill, Exmouth-street, Swindon, Wilts.
1895			Daw, Frederic Weldon, A.R.C.S., F.I.C., Eureka-place, Ebbw Vale, Mon.
1900	Trans.		Dawson, Harry Medforth, B.Sc. (Lond. and Leeds), Ph.D. (Giessen), The University, Leeds, and North-terrace, Bramley, Leeds
1899			Dawson, Henry Royal, c/o Messrs. Peyton and Son, Lister-street, Birmingham, and 6, Wimbourne-road, Edgbaston, Birmingham
1890			Day, Charles Edwin, B.Sc. (Edin.), The Mines, Coniston, Lancs.
1881	Trans.		‖Day, Thomas Cuthbert, 36, Hillside-crescent, Edinburgh
1905			Day, William Walpole, B.Sc. (Wales), Llandilo, Attleborough-road, Nuneaton
1901	Trans.		Dean, George, M.A. (Cantab.), 4, Empress-avenue, Ilford, E.
1904			Deane, Harold, B.Sc. (Lond.), A.I.C., 34, Drakefield-road, Upper Tooting, S.W.
1886			Deane, Leopold Mandeville, Birchville, 5, Whitehall-road, Rugby
1859	Trans.	{ V.P. 1871-4 }	Debus, Heinrich, Prof., Ph.D. (Marburg), F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1899			‖De Castro, John Paul, M.A. (Cantab.), F.I.C., Laboratory and Assay Office, Effingham House, Arundel-street, Strand, W.C.
1885	Trans.		Dechan, Martin, F.I.C., Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, Hollydene, Tenison-avenue, Cambridge
1903			Decks, William Thomas, High-street, Shanklin, Isle of Wight
1869	Trans.		‖Deering, William Henry, I.S.O., F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël Fielding, Blairmont, Berbice, British Guiana
1902			De la Rue, Evelyn Andros, B.A. (Oxon.), 110, Bunhill-row, E.C.
1905			De Lury, Ralph Emerson, M.A. (Toronto), The University, Toronto, Canada
1892			Denison, Joseph Richard, Lingholme, Heaton, Bradford
1902			Dennis, William, 98, Albert-road, Jarrow-on-Tyne
1906			Denton, John, Horton Villa, Bradford
1903	Trans.		Desch, Cecil Henry, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Instow, Mount Pleasant-road, South Tottenham, N.
1897			Deverell, Louis Charles, Straits Trading Co., Singapore, Straits Settlements
1870	Trans.	{ C. 1874-7 V P. 80-3 86 8, 96-7 P. 97-9 }	‖Dewar, Sir James, Prof., M.A. (Cantab.), Hon. LL.D. (St. Andrews, Aberd., Edin., Glas.), Hon. D.Sc. (Oxon., Dub., Vict., Ireland), F.R.S., F.I.C., Royal Institution, Albemarle-street, W.
1900			Dewhirst, John Arthur, F.I.C., 13, Highfield-terrace, Nab Wood, Saltaire, Bradford
1880			Dibdin, William Joseph, F.I.C., Purley Bury, Purley-downs-road, Sanderstead, Croydon

Date of Election.			
1872			‖Dickinson, Arthur John, F.I.C., Truro Villa, 57, Lewisham-high-road, S.E.
1904			Dickinson, Francis, 26, O'Connell-avenue, Dublin
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1906			Dickson, William, Branksome, Bridge of Weir, N.B.
1860	Trans.	C. 1873-4 V P. 1900-03	‖Divers, Edward, Prof., M.D. and D.Sc. (R.U.I.), F.R.S., F I.C., 3, Canning-place, Palace Gate, W.
1903			Divine, Thomas, M.D. and C.M. (Glas.), D.P.H. (Lond. and Cantab.), 30, Percy-street, Huddersfield
1897			Dixon, Andrew James, F.I.C., Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900-06	Dixon, Augustus Edward, Prof., M.D. (Dub.), Queen's College, and Fernhurst-avenue, Western-road, Cork
1896	Trans.		Dixon, Frank, B.Sc. (Lond.), The Institute, Lydney, Gloucester
1894	Proc.		‖Dixon, George, M.A. (Cantab.), Trinity College, Cambridge, and St. Bees, R.S.O., Cumberland
1876	Trans.	C. 1892-6 V.P. 1904-	‖Dixon, Harold Baily, Prof., M.A. (Oxon.), F.R.S., The University, Manchester
1893			Dixon, Harry William, Clarence Iron and Steel Works, Leeds
1902			Dixon, John Kemp Smith, c/o Messrs. H. Richardson & Co., Chemical Manure Manufacturers, York
1890			Dixon, William, 4, Park-place-east, Sunderland
1895			Dixon, William, 102, Spring-street, Bury
1862			Dixon, William Adam, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1882	Trans.	C. 1901-06	Dobbie, James Johnston, Prof., M.A. (Glas.), D.Sc. (Edin.), F.R.S., F.I.C., Museum of Science and Art, Edinburgh
1887	Trans.		Dobbin, Leonard, Ph.D. (Würzburg), F.I.C., Chemical Laboratory, New University-buildings, Edinburgh
1898			Dodd, Frederick Robertson, F.I.C., Victoria-villas, 139, Burscough-street, Ormskirk
1901			Dodd, Robert, 28, Sibella-road, Clapham, S.W.
1886			Dodd, W. Ralph, Trederwen, Village-road, Enfield, N.
1892			Dodds, George Price, 14, St. Luke's-terrace, Darlington
1905			Dodds, Roger, Kingswood School, Bath
1897	Proc.		Dodgson, John Wallis, B.Sc. (Lond.), University College, Reading
1894	Proc.		Doherty, William Michael, F.I.C., Government Laboratory, Sydney, N.S.W.
1905			Donald, Robert, M.A., B.Sc. (N.Z.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Oxon.), 75, Clyde-street, Dunedin, N.Z.
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1901	Trans.		Donnan, Frederick George, Prof., M.A. (R.U.I.), Ph.D. (Leipzig), Muspratt Laboratory, The University, Liverpool

Date of Election.		
1897	Trans.	Dootson, Frederick William, M.A. (Cantab.), D.Sc. (Dublin), F.I.C., University Chemical Laboratory, Cambridge
1902		Dorée, Charles, M.A. (Oxon.), B.Sc., Seafield Park College, Fareham, Hants.
1900		Dougall, James Dick, Senhouse-street, Maryport, Cumberland
1888		‖Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1905		Doull, John, 22, Lauriston-place, Edinburgh
1884		Down, Frederick Johnathan, Glengariff, Milton-road, Harpenden, Herts.
1899		Doyle, Frederick, Oakdene, Scotland-road, Slanwix, Carlisle
1899		Drake, Francis Alfred, B.Sc. (Lond.), 24, Cavendish-square, Hull
1884		Draper, Henry Carter, 68, Wodehouse-terrace, North Circular-road, Dublin
1891	Proc.	Dreaper, William Porter, F.I.C., Woodcroft, Felixstowe, S.O., Suffolk
1893		Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1906		Drinkwater, Lionel John, Burford, Oxon.
1902		Drought, James Justinian, Molo, *viâ* Mombasa, British East Africa
1895		Druce, Edric, County Agricultural Institute, Ridgmont, Aspley Guise, R.S.O.
1904	Trans.	Drugman, Julien, Ph.D. (Bonn), The University, Manchester
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1901		Duckworth, William Henry, Blackburn Corporation Sewage Works, Samlesbury, near Preston
1900		Dudderidge, Frank Rawlinson, 45, Sidney-grove, Newcastle-on-Tyne
1898		Dudley, Charles Benjamin, Ph.D. (Yale), Drawer 334, Altoona, Pa., U.S.A.
1890		‖Dudley, William Lofland, Prof., Vanderbilt University, Nashville, Tennessee, U.S.A.
1892		Duffield, Walter William, 5, Ashington-road, Hurlingham, Fulham, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A. (Cantab.), D.Sc. (Lond.), Laurel Bank, Claremont-road, Headingley, Leeds.
1897		Dufty, Lawrence, 8, Clarke-street, Sheffield
1884		Duggan, Thomas Richard, F.I.C., 60, Foyle-road, Blackheath, S.E.
1889		Duisberg, Carl, Prof., Ph.D., Elberfeld, Germany
1889		‖Dukes, Thomas William, P.O. Box 10, Vryheid, South Africa
1881		Duncan, Arthur William, 1, Trafalgar-road, Higher Bentcliffe, Pendleton, Manchester

Date of Election.			
1894	Proc.		‖Duncan, Cecil Cooke, F.I.C., The Shire Hall, Worcester
1906			Duncan, Robert Kennedy, Prof., University of Kansas, Lawrence, Kansas, U.S.A.
1891			Duncan, William, F.I.C., The Laboratory, 65, Bath-row, Edgbaston, Birmingham
1896			Duncan, William, Royal Dispensary, 21, West Richmond-street, Edinburgh
1905			Dunlop, Harry, Cragdarroch Cove, Dumbartonshire, N.B.
1894	Proc.		‖Dunn, Frederic, 193, Collins-street, Melbourne, Australia
1882			Dunn, John Thomas, D.Sc. (Dun.), F.I.C., 10, Dean-street, Newcastle-on-Tyne
1893			Dunnington, Francis Perry, University of Virginia, Charlottesville, U.S.A.
1899			Dunscombe, Frederick Charles, c/o Electric Reduction Co., Buckingham, Quebec, Canada
1901	Trans.		Dunstan, Albert Ernest, B.Sc. (Lond.), East Ham Technical College, East Ham, E.
1885			Dunstan, Malcolm James Rowley, M.A. (Oxon.), F.I.C., The College, Wye, Kent
1905			Dunstan, Sydney, The Royal Infirmary, Newcastle-on-Tyne
1879	Trans.	C. 1888-91 S. 93-1903 V.P. 1903-06	‖Dunstan, Wyndham Rowland, Prof., Hon. M.A. (Oxon.), Hon. LL.D. (Aberdeen), F.R.S., F.I.C., Imperial Institute, S.W.
1860	Trans.	C. 1871-5	Dupré, August, M.A. and Ph.D. (Heidelberg), F.R.S., F.I.C., 2, Edinburgh Mansions, Howick-place, S.W.
1896			Durant, Henry Thomas, The Rhodesia Gold Fields, Ltd., Bulawayo, Matabeleland, South Africa
1871			‖Durham, Henry, 13, Coleherne-road, South Kensington, S.W.
1906			Durrans, Thomas Harold, 1, Cornwall-terrace, Regent's Park, N.W.
1883	Trans.		Durrant, Reginald Graham, M.A. (Oxon.), The College, Marlborough, Wilts.
1892			Duxbury, Thomas, 17, Grosvenor-chambers, Deansgate, Manchester
1875	Trans.	C. 1893-7 1904-	‖Dyer, Bernard, D.Sc. (Lond.), F.I.C., 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, F.I.C., Board of Education, South Kensington, S.W.
1885	Trans.		Dyson, Gibson, Ph.D., Venn Farm, Marden, Hereford
1883	Trans.		‖Dyson, Septimus, 8, Belmont-avenue, Harrogate
1905			Eade, Samuel George, 10, Eagle-street, Port Talbot, South Wales
1876			‖Earp, Francis Salsbury, Ph.D. (Giessen), F.I.C., 72, Addis-street, Kalgoorlie, West Australia

Date of Election.		
1889	Trans.	‖Easterfield, Thomas Hill, Prof., M.A. (Cantab.), Ph.D. (Würzburg), F.I.C., The Victoria College, Wellington, New Zealand
1891		Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
1881		Eastick, John Joseph, F.I.C., Millaquin Refinery, Bundaberg, Queensland
1903		Eastwood, Arthur William, B.A. (Cantab.), Newton College, Newton Abbot, South Devon
1878	Trans.	‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1906		Edgell, Cecil Wyatt-, B.A. (Oxon.), Cowrey-place, Exeter
1881		Edgell, Richard Arnold, Rev., M.A. (Oxon.), Sywell House, Llandudno, Wales
1903		Edgerton, John Percy, The Laboratory, 61, Cornhill, E.C.
1902		Edlin, Edgar Leeder, B.A. (Oxon.), 31, All Saints-road, Leicester
1902		Edminson, Sidney Robert, Maritzburg College, Natal, South Africa
1893		Edwards, Thomas, Ty Mawr, Rhymney, viâ Cardiff
1884		Edwards, Vincent, F.I.C., c/o Lawes' Chemical Manure Co., Barking Creek, Essex
1892		Edwards, Walter Nicholas, 6, Shardcroft-avenue, Herne Hill, S.E.
1898		‖Edwards, Wilbraham Tollemache Arthur, M.R.A.C., F.I.C., The Laboratory, Phœnix, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany
1899		Eichenauer, William Frederick, 18, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, F.I.C., 143, New Bond-street, W.
1883		‖Ekins, Arthur Edward, J.P., F.I.C., Rushden, Lattimore-road, St. Albans
1903		Elford, Archibald Sefton, M.A. (Oxon.), 41, Broomfield-road, Chelmsford
1891		Elford, Percy, M.A. (Oxon.), St. John's College, Oxford
1878	Trans.	‖Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, Walter John, M.A. (Cantab.), Woodcroft, Lichfield-road, Stafford
1893		Ellis, Charles Sordes, F.I.C., Meadowlead, Station-road, Harrow
1900		Ellis, Frederic Richard, 15, Shadwell-road, Bishopston, Bristol
1903		Ellis, Henry Russel, 177, Warwick-road, Kensington, W.
1901		Ellis, Hugh Edward, Preswylfa, Llanfair, near Welshpool
1878		Ellis, William Hodgson, Prof., M.A. (Cantab.), M.B. (Toronto), F.I.C., School of Practical Science, Toronto, Ontario, Canada

Date of Election.		
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1893		Elmore, Alexander Stanley, 4, Broad-street-place, E.C.
1902		Elsden, Alfred Vincent, B.Sc. (Lond.), A.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E.
1885		Embrey, George, F.I.C., County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton, The Copse, Hamble, Southampton
1901		English, Robert, Engineer and Manager, Christchurch Gas Co., Christchurch, New Zealand
1892		Entwistle, Herbert, 1, Albert-place, Dickenson-road, Longsight, Manchester
1899		Epps, James Washington, 95, Upper Tulse Hill, S.W.
1889		Erskine, James Kerr, New Kleinfontein Co., Ltd., Post Office, Benoni, Transvaal, South Africa
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862		‖Esson, William, Prof., M.A. (Oxon.), F.R.S., Merton College, Oxford
1865		‖Estcourt, Charles, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1899		Estcourt, Harry Estcourt, 467, West-street, Durban, Natal, South Africa
1888		‖Estcourt, Philip Anderson, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1894		Eumorfopoulos, Nicholas, B.Sc. (Lond.), 33, Gloucester-square, Hyde Park, W.
1895		Eutroppe, Arthur Theophilus, Fort Keogh, Montana, U.S.A.
1905		Evans, Bernard Scott, B.Sc. (Lond.), 86, Valley-road, Streatham, S.W.
1904		Evans, Edward, The Laboratory, South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1891		Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope, South Africa
1906		Evans, Frederick Watkins, 11, High-street, Cardigan
1876		Evans, Sir John, K.C.B., D.C.L. (Oxon. and Toronto), LL.D. (Dublin and Toronto), Sc.D. (Cantab.), F.R.S., Nash Mills, Hemel Hempstead
1904		Evans, John, F.I.C., 67, Surrey-street, Sheffield
1892	Trans.	‖Evans, Robert Cecil Turle, 280, Philip-lane, West Green, Winchfield
1904		Evans, Nevil Norton, McGill University, Montreal, Canada
1888		‖Everard, Arthur George, 4, St. George's-road, Barnstaple
1902		Everitt, Walter, 83, The Grove, Ealing, W.
1894		Evershed, Frank, Kenley, Surrey

Date of Election.			
1896	Trans.		Ewan, Thomas, M.Sc. (Vict.), Ph.D. (Munich), c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1902	Trans.		Eynon, Lewis, B.Sc. (Lond.), F.I.C., 57, Darenth-road, Stamford Hill, N.
1901	Trans.		Eyre, John Vargas, 26, Bridge-road-west, Battersea Park, S.W.
1888			Faber, Harald Nicolai, 7 and 8, Idol-lane, E.C.
1904			Fagan, Thomas Wallace, M.A. (Cantab.), Talysarn, Penygroes, R.S.O., North Wales.
1903			Fairhall, Edwin Jesse, A.C.G.I., A.I.C., 8, Scarborough-road, Stroud Green, N.
1865	Trans.		‖Fairley, Thomas, F.I.C., 17, East-parade, Leeds
1895			Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899			Fairweather, Ernest Barratt, King's College Hospital, Lincoln's Inn Fields, W.C.
1888			Farlie, John Burke, 54, Wellington-road, Old Charlton, Kent
1903	Trans.		Farmer, Robert Crosbie, M.Sc. (Vict.), Ph.D. (Würzburg), Holmesdale, Pickford-road, Bexley Heath, Kent
1895			Farr, Edward Henry, Uckfield, Sussex
1870			‖Farries, Thomas, F I.C., 16, Coleman-street, E.C.
1880			‖Farrington, Thomas, M.A. (Q.U.I.), F.I.C., 5, Summerhill-terrace, Wellington-road, Cork
1902			Fasnacht, Eugène Arthur, The Hollies, Clayton Bridge, Manchester
1894			Fawcett, Joseph Addey, 54, Broxholme-lane, Doncaster
1887			Fawsitt, Charles Albert, 9, Foremount-terrace, Dowanhill, Glasgow
1903	Trans.		Fawsitt, Charles Edward, D.Sc. (Edin.), Ph.D. (Leipzig), Chemical Department, The University, Glasgow
1900			Fechtner, Arthur Louis William, 5, Rue de la Porte Rosette, Alexandria, Egypt
1906	Proc.		Feilmann, Martin Ernest, B.Sc. (Lond.), Ph.D. (Basel), F.I.C., 92, Victoria-street, S.W.
1888			Fell, John Campbell, Lansdown Cottage, Ryde, Isle of Wight
1897			Fenby, Alarick Vincent Colpoys, B.Sc. (Lond.), Hutton Grammar School, near Preston, Lancs.
1878	Trans.	{C. 1898-1902}	‖Fenton, Henry John Horstman, M.A., Sc.D. (Cantab.), F.R.S., F.I.C., Christ's College, and 19, Brookside, Cambridge
1898			Ferguson, James Edward, Laboratory and Assay Office, 2, Union-court, Old Broad-street, E.C.
1872		C. 1880-93	‖Ferguson, John, Prof., M.A. (Glas.), LL.D. (St. Andrews), F.I.C., The University, Glasgow
1901			Ferguson, Reginald William, B.Sc. (Lond.), A.R.C.S., Municipal Technical School, The Gamble Institute, St. Helens

Date of Election.			
1899			Fermor, Herbert Frederick Francis Burdett, 15, Ansdell-road, Peckham, S.E.
1902			Ferrand, Frederick, 13, Torrington-street, Hopwood, Heywood
1864			‖Ferreira, A. A.
1882			Ferrier, James, Columbus, Georgia, U.S.A.
1905			Ferrier, John Greig, 6, Brunswick-square, Port of Spain, Trinidad, West Indies.
1902			Ferrier, John Oliver, Ackland House, Slave Island, Colombo, Ceylon
1902			Ferris, Percy James, Willowmore, New-road, Lymm, Cheshire
1904			Field, William Eddington, 65, Sutherland-road, Armadale, Melbourne, Australia
1895			Fielding, Patrick Joseph Dominick, 66, Patrick-street, Cork
1906	Trans.		Fierz, Hans Eduard, Ph.D. (Zürich), 119, Mühlebachstrasse, Zürich, V, Switzerland
1900	Trans.		Findlay, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Leipzig), The University, Birmingham
1905			Findon, Frank Standish, Rev., M.A. and B.Sc. (St. Andrews), 41, Great Percy-street, Holford-square, W.C.
1904			Finlow, Robert Steel, B.Sc. (Wales), c/o Messrs. Grindlay and Co., Calcutta, India
1905	Trans.		Finnemore, Horace, F.I.C., 21, Linden Mansions, Highgate, N.
1896			Fisher, Ernest Hunter, The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A. (Oxon.), F.I.C., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Sir Frederick William, Bart., M.A. (Oxon.), 64, Pont-street, S.W.
1900			FitzGibbon, Thomas, 115, Harbord-street, Fulham, S.W.
1896			Fleet, John Thomas, 24, Sheep-street, Rugby
1899			‖Fleischmann, Friederich Noël Ashcroft, 4, Orme-court, W.
1898			‖Fleming, John Arnold, Britannia Pottery, 136, Glebe-street, Glasgow
1903			Fletcher, Alan, 114, Beaufort-street, South Kensington, S.W.
1874			Fletcher, Frederick William, North London Chemical Works, Holloway, N., and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A. (Oxon.), F.R.S., Natural History Department, British Museum, Cromwell-road, S.W., and 35 Woodville-gardens, Ealing, W.
1894			‖Flintoff, Robert John, Gale Print Works, Littleborough, Lancs.
1892			Floris, Robert Brooke, F.I.C., Church House, West Hanningfield, near Chelmsford
1906			Flurscheim, Bernhard, Ph.D. (Heidelberg), Heatherlands, Fleet, Hants.
1894			Fogg, Charles Albert, Graythorne, Albert-road, Bolton

Date of Election.			
1859			Fogg, Thomas, 93, Portsdown-road, Maida Vale, W.
1889			Foggie, John, University College, Dundee
1902			Foll, Edgar, The Cottage, The Lion Brewery, Belvedere-road, Lambeth, S.E.
1885			Follows, Harold, 4, Kensington-avenue, Victoria-park, Manchester
1894			‖Forbes, Donald Gordon, The Post Office, Victoria, British Columbia
1874	Trans.		Forbes, James, jun., 70, Gracechurch-street, E.C.
1889			Ford, John Simpson, c/o Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton
1904			Forrest, James Rocheid, Lieut.-Col., R.A.M.C., D.P.H. (Cantab.), Station Hospital, 18, Camp, Ahmedabad, India
1904			Forrest, John Kerr, Hawsleigh, Balaclava-road, St. Kilda, Victoria, N.S.W.
1893			Forrester, Alexander Machattie, c/o Messrs. Laidlaw, MacKill and Co., Ltd., 3400, Williamsburg-avenue, Richmond, Virginia, U.S.A.
1905			Forster, Ernest Lyle Carman, M.A. (Toronto), Chemical Department, The University, Toronto, Canada
1892	Trans.	C. 1901-04. S. 1904-	‖Forster, Martin Onslow, D.Sc. (Lond.), Ph.D. (Würzburg), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.
1903			Forster, William, 30, Church-street, Seaham Harbour
1856	Trans.	C. 1865-8, 72-5, 85-6 V.P. 88-92	‖Foster, George Carey, Prof., B.A. (Lond.), LL.D. (Glas.), D.Sc. (Vict.), F.R.S., Emeritus Professor of Physics, University College, Gower-street, W.C., and Ladywalk, Rickmansworth, Herts.
1872			Foster, Reginald Le Neve, Bollindene, Wilmslow, Cheshire
1906			Foucar, James Louis, B.Sc. (Lond.), 20, St. John's-park, Blackheath, S.E.
1900			Foulds, James, A.R.C.S., 6, Leach-street, Belgrave-road, Darwen, Lancs.
1898			Foulerton, Alexander Grant Russell, F.R.C.S. (Eng.), L.R.C.P., (Lond.), D.P.H. (Cantab.), Haywards Heath, Sussex
1891	Trans.		‖Fowler, Gilbert John, D.Sc. (Vict.), F.I.C., Broad Oak, Urmston, Manchester
1900			Fowler, Morris Broad, 19, Westbury-road, Westbury-on-Trym, near Bristol
1882			‖Fowler, William, 1, Grace-terrace, Sunderland
1895			Fox, Albert Stanley, Rosehurst, Athelstan-road, Faversham
1906			Foye, Peter Bertram, 16, Burlington-road, Dublin
1879			Francis, Edward, Ivy Bank, Park-ravine, Nottingham

Date of Election.			
1902	Trans.		Francis, Francis Ernest, Prof., Ph.D. (Erlangen), D.Sc. (Vict.), F.I.C., University College, Bristol
1873			‖Francis, George Bult, 38, Southwark-street, S.E.
1881			Frankland, Henry, F.I.C., Streonshalh, The Crescent, Linthorpe, Middlesbro'.
1880	Trans.	C. 1887-9 V.P. 1902-05	‖Frankland, Percy Faraday, Prof., Hon. LL.D. (St. Andrews), Ph.D. (Würzburg), Hon. M.Sc. (Birm.), B.Sc. (Lond.), A.R.S.M., F.R.S., F.I.C., The University, Birmingham
1867			‖Fraser, Angus, M.A., LL.D. (Aberd.), M.D., C.M. (Aberd. and Paris), 232, Union-street, Aberdeen
1892			‖Fraser, James Christopher, Mercantile-chambers, Victoria-square, Adelaide, South Australia
1885			Freear, Harry Marshall, Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick William, Heatherdale, Spenser-road, Harpenden, Herts.
1900			Freeman, Willie Ludford, M.A. (Oxon.), 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph Thomas, Limehurst, Plymyard-avenue, Bromboro', Cheshire
1892	Proc.		French, William, M.A. (Cantab.), F.I.C., Storey Institute, Lancaster
1903	Trans.		Friend, John Albert Newton, M.Sc. (Birm.), Leistenstrasse 6/II, Würzburg, Germany
1871	Trans.	C. 1884-9, 92-6	‖Friswell, Richard John, F.I.C., Fairfield, Bexley, Kent
1890			‖Frost, Robert, B.Sc. (Lond. and Vict.), 55, Kensington-court, Kensington, W.
1904			‖Fry, George, Carlin Brae, Berwick-on-Tweed
1899			Fry, George Cecil, M.Sc. (Vict.), F.I.C., 71, George-street, Saltaire, Shipley, Yorks.
1899	Trans.		Frye, Colin Charlwood, 11, King's-avenue, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A. and Ph.D. (Leipzig), F.I.C., 13, Eaton-crescent, Clifton, Bristol
1891			Fulcher, Lionel William, B.Sc. (Lond.), Victoria and Albert Museum, S.W., and Ingleside, 37, Kempshott-road, Streatham Common, S.W.
1896			Fuller, Charles James Pemeller, 603, Chorley-new-road, Horwich, near Bolton, Lancs.
1886			Fuller, John, Rookwood, 24, Mount-park-crescent, Ealing, W.
1894			‖Gabb, George Hugh, 83, Crayford-road, Tufnell-park, N.
1899			Gabriel, Edmund Vivian, M.A. (Cantab.), C.V.O., United Service, Simla, India
1901			Gadd, Henry Wippell, 27, East Southernhey, Exeter
1901			Gajjar, Tribhuvandas Kalyandas, Prof., M.A. and B.Sc. (Bombay), Gingaum, Bombay, India

Date of Election.		
1866		Gale, James, M.A., Ph.D., 124, Adelaide-road, South Hampstead, N.W.
1905		Gall, John Beaconsfield, F.I.C., Knoxland, Erith-road, Belvedere, Kent
1851		‖Gamble, Sir David, Bart., K.C.B., Windlehurst, St. Helens, Lancs.
1876		Gamble, Josias Christopher, Haresfinch, St. Helens, Lancs.
1903		Gandy, William Hunter, Bradley Court, Mitcheldean, Gloucester
1883	Proc.	‖Garbutt, Llewellyn, M.A. (Cantab,), The College, Winchester
1903		Gardiner, Ernest Alexander, B.A. (Oxon.), The College, Plymouth
1888		Gardiner, James Henry, 59, Wroughton-road, Balham, S.W.
1905		Gardner, Charles Richard, Chemical Laboratory, Gathurst, near Wigan
1906		Gardner, Edward, 70, Parliament-hill-mansions, Highgate-road, N.W.
1901		Gardner, Hermann Charles Thomas, Miller Hospital and Royal Kent Dispensary, Greenwich-road, S.E.
1893	Trans.	Gardner, John Addyman, M.A. (Oxon.), F.I.C., Chemical Department, St. George's Hospital, S.W.
1888		Gardner, Walter Myers, Prof., M.Sc. (Leeds), Technical College, Bradford, and 3, Fairmount, Manningham, Bradford
1902		Garle, John Longsdon, F.I.C., 136, Holland-road, Kensington, W.
1893	Trans.	Garnett, Henry, 48, Deansgate, Manchester.
1889	Trans.	Garrett, Frederic Charles, M.Sc. (Vict.), Armstrong College of Science, Newcastle-on-Tyne
1898		Garside, Arthur Leonard Harry, 6, Cotswold-terrace, Lower Broughton-road, Manchester
1906		Garvey, Richard Godfrey Hamilton, 25, Park-mansions, Battersea, S.W.
1884		Gaskell, Joseph, 71, Haworth's-buildings, Cross-street, Manchester
1900		Gasson, William, Dutoitspan-road, Kimberley, South Africa
1903		Gatehouse, Frank Brooks, The Analytical Laboratory, Broad-street, Bath
1904	Trans.	Gawler, Robert, M.Sc. (Vict.), 3, South View-terrace, Bennett-road, Headingley, Leeds
1887		Geisler, Joseph Frank, Mercantile Exchange Buildings, Hudson and Harrison-streets, New York, U.S.A.
1885		Gemmell, George Harrison, F.I.C., 4, Lindsay-place, Edinburgh
1903		Gent, Percy William, 789, Highland-avenue, Forest Hill, Newark, New Jersey, U.S.A.
1879		‖Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Director of Technical Instruction, Auckland, New Zealand

Date of Election.		
1904		Gerard, Thomas Alfred, 122, Foxhall-road, Nottingham
1889		‖Gerland, Conrad, M.Sc. (Vict.), Ph.D. (Marburg), Meadow Bank, Accrington
1891		German, George, jun., Mansion House, Ashby-de-la-Zouch
1895		‖Gerrans, Henry Tresawna, M.A. (Oxon.), 20, St. John-street, Oxford
1875		Gerrard, Alfred William, 35, Queen's-road, Wimbledon, S.W.
1899		Getman, Frederick Hutton, 811, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Lieut.-Col. I.M.S., F.I.C., Chemical Examiner, Medical College, Madras, India
1904		Ghose, Anukul, 42, Shambazar-street, Calcutta, India
1890		‖Gibbes, Cuthbert Chapman, M.D. and C.M., (Aberd.), M.R.C.P. (Lond.), D.P.H. (Cantab.), 89, Harley-street, W.
1900		Gibbings, George William, Standard Bank of South Africa, Salisbury, Rhodesia, South Africa
1897		Gibbons, Joseph Lake, The Higher Grade School, Blyth, Northumberland
1906		Gibbs, Reginald William Malyon, B.A. (Cantab.), B.Sc. (Lond.), The Grammar School, Spilsby, Lincs.
1900		Gibson, John, St. Oswald's road, Hexham
1892	Trans.	Gibson, John, Prof., Ph.D. (Heidelberg), F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1888		Gibson, William Humphrey, 122, King's-road, Brighton
1898		Gidden, William Thomas, The Hawthorns, Moat-road, Langley, near Birmingham
1895		Gilbard, John Francis Hutchins, F.I.C., 245, Dalston-lane, Hackney, N.E.
1904		Gilchrist, James Gray, M.A. (Aberd.), B.Sc. (Lond.), Newseat, Rothienorman, Aberdeenshire
1898		Gilderdale, Frederick, 3, Havelock-street, Newcastle-on-Tyne
1883		‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants.
1888		Gill, John, Gwealhellis, Helston, Cornwall
1902		Gill, J. Arthur, Pennsylvania, Lower-green-road, Rusthall, Tunbridge Wells
1898	Proc.	Gilles, William Setten, F.I.C., The Cottage, Bocking, Braintree, Essex
1905		Gillies, Albert, Government Laboratories, Johannesburg, South Africa
1865		‖Gillman, A. W.
1901		Gillman, Edward, Government Laboratory, Barbados, West Indies
1885		Girdwood, Gilbert Prout, M.D. and C.M. (McGill), M.R.C.S. (Eng.), F.I.C., 111, University-street, Montreal
1897		Girtin, Thomas, M.A. (Cantab.), 125A, Highbury New Park, N.

Date of Election.			
1898			Glaister, John, Prof., M.D. (Glas.), M.R.C.S. and L.R.C.P. (Edin.), 18, Woodside-place, Glasgow
1905			Glass, Archibald Melville, B.Sc. (Lond.), 37, Chancery-lane, W.C.
1872			‖Glover, George Thomas, F.I.C., 24, Craven-hill-gardens, Lancaster Gate, W.
1904			Glover, Harry James, Mount Pleasant, Wrattle-road, Westham, near Hastings
1906			Glover, Walter Harris, Ph.D. (Leipzig), 38, Ribblesdale-road, Streatham Park, S.W.
1895			Goldfinch, George, 7, Church-walk, Hendon, N.W.
1899			Golding, John, F.I.C., Midland Agricultural and Dairy Institute, Kingston, Derby
1878			‖Goldschmidt, S. A., Ph.D., c/o Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, New York, U.S.A.
1889			Goldsmith, Byron B., Ph.B. (Columbia), 19, East 74th-street, New York City, U.S.A.
1898			Goldsmith, John Naish, B.Sc. (Vict.), Ph.D. (Heidelberg), British Xylonite Co., Manningtree, Essex
1899			Goltz, Harold Francis Carl, 155, Brixton Hill, S.W.
1897			Gomess, Alfred Francis Bilderbeck, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 33, Drayton-gardens, South Kensington, S.W.
1904			‖Goodson, John Augustus, A.I.C., Gordon College, Khartoum, Africa
1890			Goodwin, Thomas Small, Prof., M.B. and C.M. (Glas.), F.R.S.E., 1, Heron-terrace, St. Margarets, Twickenham
1896	Trans.		Goodwin, William, Thorncliffe, Macclesfield
1890			Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1875			Gordon, Joseph Gordon, F.I.C., Queen Anne's-mansions, Westminster, S.W.
1905			Gorman, Henry Isaac, 126, Quay, Waterford, Ireland
1890			Gossling, Frank, B.Sc. (Lond.), H.M. Patent Office, Staple Inn, W.C.
1889	Trans.		‖Gott, Benjamin Scaife, M.A. (Cantab.), The Guildhall, Westminster, S.W.
1903			Gough, Henry, 188, Weaste-lane, Pendleton, Manchester
1900			Gough, John Henry, 65, Grange-avenue, Chapeltown-road, Leeds
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, D.Sc. (Lond.), F.I.C., 98, Stroud Green-road, N.
1887			Gover, Herbert James, 29, Piccadilly, Hanley, Staffs.
1889			Gow, Robert John, Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, Ashleigh, Furness Park-road, Barrow
1871	Trans.	C. 1898-01 1906.	‖Gowland, William, Prof., A.R.S.M., F.I.C., 13, Russell-road, Kensington, W.

Date of Election.			
1887	Trans.		Goyder, George Arthur, Hawkins-road, Medindie, Adelaide, South Australia
1884			Grace, William Frank, 30, Hartington-villas, Hove, Sussex
1862		C. 1880-1	‖Graham, Charles, Prof., D.Sc. (Lond.), F.I.C., The Reculvers, Hastings
1880	Trans.		‖Graham, Christopher Colborne, F.I.C., Oriel House, Scarborough.
1890	Trans.		Grant, James, F.I.C., Oaklands, Gardner-road, Prestwich, near Manchester
1887			Gravill, Edward Day, F.R.M.S., 42, Walmsley-street, Hull
1882			Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900	Trans.		Gray, Robert Whytlaw, 7, Orme-court, Bayswater, W.
1892	Trans.		Gray, Thomas, Prof., D.Sc. (Glas.), Ph.D. (Jena), The Technical College, Glasgow
1895			Greaves, William Abraham, 23A, Broad-bank, Louth, Lincs.
1890			Green, Alfred Henry, A.I.C., Oaklands, Lowton, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, Prof., M.Sc. (Vict.), F.I.C., The University, Leeds ; and 49, Cardigan-road, Headingley, Leeds
1902	Trans.		Green, Clarence James, B.Sc. (Vict.), c/o Messrs. Nicholson and Co., Beaumont Works, St. Albans
1905			Green, Ernest, 113, Hulton-street, Moss Side, Manchester
1902			Green, George Felix Dudbridge, A.I.C., c/o Messrs. Davey and Co., Gainsboro'-road, Hackney Wick, N.E.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, A.R.S.M., West Clyne, Stretford, Manchester
1878			Green, Lawrence, Lower Tovil, Maidstone
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey,
1885			Greenway, Thomas John, F.I.C., 60, Brookman's-buildings, Grenfell-street, Adelaide, South Australia
1894	Proc.		Greeves, Alfred, 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D. and B.S. (Dun. and Cape of Good Hope), M.R.C.S. and D.P.H. (Eng.), B.Sc., Colonial Secretary's Office, Cape Town, South Africa
1906	Trans.		Gregory, Thomas William Diggle, Lynton, Basford-park, Stoke-on-Trent
1874			Greville, Henry Leicester, F.I.C., 39, Croft-road, Bromley, Kent
1896			Grice, Walter Thomas, 9, Dalhousie-square, Calcutta, India
1888			‖Griffith, David Agnew, The Houghlands, Kelsall, Chester
1905			Griffiths, John, B.Sc. (Wales), The Hollies, Upton-park, Chester

Date of Election.			
1902			Griffiths, John Thomas, 9, Greenhill-avenue, Tenby, South Wales
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 3, Hill-side, Lancaster
1902			Grimwade, Wilfrid Russell, B.Sc. (Melbourne), 342–346, Little Flinders-street, Melbourne, Australia
1880			Grimwood, Robert, F.I.C., Chemical Department, London County Council, 40, Craven-street, W.C.
1893			Grimwood, Robert George, F.I.C., 43, Leaside-avenue, Muswell Hill, N.
1906			Grindley, Harry Sands, Prof., D.Sc. (Harvard), B.Sc. (Illinois), State University, Urbana, Illinois, U.S.A.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire
1900			Gritton, Henry Bertie, The Royal Mint, Sydney, N.S.W.
1895			Grossman, Edward Henry, 12, Alfred-place-west, South Kensington, S.W.
1871	Trans.	C.1877-8 V.P. 1899-1902.	‖Groves, Charles Edward, F.R.S., F.I.C., Kennington Green, S.E.
1902			Groves, Samuel Ernest, Ingleside, Bridle-road, South Boldon, Co. Durham
1901			Groves, William Peer, B.A. (Cantab.), Green Bank, Plumbley, Cheshire
1897			Grundey, Frederick Roscoe, B.Sc. (Vict.), 33, Woodburn-square, Douglas, Isle of Man
1903			Grundy, Frank Barnes, F.I.C., Victoria Mills, Bredbury, near Stockport
1897			Guest, Edward Graham, M.A. (Cantab.), B.Sc. (Lond.), 5, Churchill, Edinburgh
1902			Gumersall, Edward, 21, New-road, Rochester, Kent
1895			Gunn, Alexander, 13, Wilby-terrace, Fulwich-road, Dartford, Kent
1902			Gunn, Gilbert, 29, Bury-old-road, Heywood, Lancs.
1906			Gupta, Hem Chandra Dutt, Prof., M.A. (Calcutta), Tej Narayan Jubilee College, Bhagalpur, Bengal, India
1899			Gurney, Elliott Henry, Agricultural College, Gatton, Queensland, Australia
1898			Guthrie, Alexander, B.Sc. (Glas.), Inglewood, Eaton-road, Coventry
1888	Trans.		Guthrie, Frederick Bickell, F.I.C., Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1904	Trans.		Guthrie, John Monteath, 199, Ferry-road, Leith, N.B.
1904	Trans.		Guttmann, Leo Frank, Ph.D. (Heidelberg), A.I.C., The College of the City of New York, New York City, U.S.A., and 18, Aberdare-gardens, N.W.
1897			Guttmann, Oscar, F.I.C., 12, Mark-lane, E.C.

Date of Election.			
1902	Trans.		Haas, Paul, D.Sc. (Lond.), Ph.D. (Freiburg), 11, Westbourne-park-road, W.
1874			Habirshaw, William Martin, 341, Madison-avenue, New York, U.S.A.
1878			‖Hadkinson, John.
1894			Hadley, Arthur, c/o Messrs. Crowley & Co., Ltd., The Brewery, Alton, Hants.
1898			Hadley, Edwin Bernard, Dalham Villa, Granville-road, Southfields, S.W.
1893			‖Hadley, Henry Edwin, School of Science, Kidderminster
1886	Trans.		Haga, Tamemasa, D.Sc., College of Science, University of Tokio, Japan
1905			Haigh, Sidney Montague, St. Edmund's-avenue, Port-hill, Stoke-on-Trent
1899			Haigh, Percy, St. Catherine's, Hurstpierpoint, Sussex
1881			Hailes, Alfred James de, F.I.C., 15, Red Lion-square, W.C.
1892			Haines, Walter Stanley, Prof., c/o Rush Medical College, Chicago, U.S.A.
1876	Trans.		Hake, Henry Wilson, Ph.D. (Giessen), F.I.C., Westminster Hospital Medical School, Caxton-street, S.W.
1893			Hale, Henry Ormsby, Oundle School, Northants.
1891	Trans.	C. 1904–	Hall, Alfred Daniel, M.A. (Oxon.), Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.
1889			Hall, Allan Twistleton, c/o Messrs. Sissons Bros. and Co., Ltd., Hull
1891			Hall, Archibald, F.I.C., 34, Bishopsgate-street, E.C.
1889	Trans.		Hall, John Albert, M.Sc. (Manc.), Victoria Chemical Works, Victoria, British Columbia
1903			Hall, John Thomas, West View, Stanwell, Staines
1906			Hall, Richard John, M.Sc. (Vict.), F.I.C., Sandycroft, Serpentine-road, Egremont, Liverpool
1876			Hall, Samuel, F.I.C., East London Soap Works, Bow, E.
1899			‖Hall, Samuel Godfrey, 19, Aberdeen-park, Highbury, N.
1893			Haller, Albin, Prof., 1, Rue de Goff, Paris
1886			Halliburton, William Dobinson, Prof., M.D., B.Sc. and F.R.C.P. (Lond.), M.R.C.S., (Eng.), F.R.S., Church Cottage, 17, Marylebone-road, N.W.
1897			Halliwell, Edward, F.I.C., c/o Ribble Joint Committee, 2, Stanley-place, Preston
1902			Hallowell, Thomas Butterworth, Ladyshawe House, New Mills, West Stockport
1900			Halstead, Reginald Gordon, 12 and 16, Coleman-street, E.C.
1890	Trans.		Hambly, Frederick John, F.I.C., c/o The Electric Reduction Co., Buckingham, Quebec, Canada

Date of Election.			
1888	Trans.		Hamilton, James Cullen, Arncliffe, Arnside, viâ Carnforth
1898			Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks.
1897			Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans		Hamlet, William Mogford, F.I.C., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1904			Hammond, Harold Sankey, Agricultural Experiment Station, Kingston, Rhode Island, U.S.A.
1901			Hammond, Herbert Blackmore, 41, St James'-street, Dover
1857			Hanbury, Cornelius, F.I.C., Plough-court, Lombard-street, E.C., and Dynevor House, Richmond, Surrey
1900			Handcock, Walter Augustus, A.I.C., Pentlands, 39, The Avenue, Beckenham, Kent
1895	Trans.		Hanes, Edgar Septimus, F.I.C., 27, Lyncroft-mansions, Lyncroft-gardens, Hampstead, N.W.
1896			Hanger, Ralph Hamilton, Hawthorn-villa, Newland, Hull
1900			Hanley, John, F.I.C., 74, Rowson-street, New Brighton, Cheshire
1902	Trans.		Hann, Archie Cecil Osborn, 54, Wood-vale, Forest Hill, S.E.
1872	Trans.		‖Hannay, James Ballantyne, F.I.C., Cove Castle, Loch Long, N.B., and Whitehall Club, S.W.
1889			‖Hanson, Alfred Miall, The Marjorie, Whalley, near Blackburn
1901	Trans.		Hanson, Edward Kenneth, M.A. (Cantab.), F.I.C., Mapledene, Hadley Wood, N.
1895			Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on-Tees
1897			Harbord, Frank William, F.I.C., Surbiton House, Englefield Green, Surrey
1859	Trans.	S. 1865-73 V.P.73-6, 80-3, 92-5 P. 1895-7	‖Harcourt, Augustus George Vernon, M.A. (Oxon.), Hon. D.C.L. (Dun.), Hon. LL.D. (Montreal), F.R.S., F.I.C., St. Clare, Ryde, Isle of Wight
1863			‖Harcourt, Leveson Francis Vernon, M.A. (Oxon.), M.Inst.C.E., Haddon House, Weybridge
1887	Trans.	C. 1902-05	‖Harden, Arthur, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C., 2, Marlborough-road, Richmond, Surrey
1902			Harding, Herbert, B.Sc. (Lond.), 47, Streathbourne-road, Upper Tooting, S.W.
1885			Hards, William Benjamin, B.A. (Lond.), Board of Education, Whitehall, S.W.
1892			Hardy, James Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1874			Hargreaves, Andrew Fuller, Esk Hill, Rosslyn, Midlothian
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes, Lancs.
1884			Hargreaves, John, F.I.C., Widnes, Lancs.

Date of Election.		
1901		Hargreaves, William Arthur, M.A., B.C.E. (Melbourne), F.I.C., Government Analyst, Adelaide, S. Australia
1901		Harker, George, D.Sc. (Sydney), 35, Boulevarde, Petersham, Sydney, N.S.W.
1876		‖Harland, Robert Henry, F.I.C., 37, Lombard-street, E.C.
1878		‖Harland, William Dugdale, 48, King-street, Manchester
1897		Harley, Vaughan Berkeley, Prof., M.D. (Edin.), M.R.C.P. (Lond.), 25, Harley-street, W.
1874		‖Harman, Frederick Edwin, c/o Dr. Piggott, 13, Orchard-gardens, Teignmouth, Devon
1897		Harman, Harold Wallis, Felday, Prentis-road, Streatham, S.W.
1903		Harmer, Francis Gerald, Middle Class School, Vernon-road, Leeds
1904		Harold, Frederick Clarkson-, 23, Chesnut-grove, Birkenhead
1899		Harper, Henry Winston, M.D. (Virginia), The University of Texas, Austin, Texas, U.S.A.
1897		Harrie, Harold William, Lyndhurst, 25, Northwold-road, Stoke Newington, N.
1897		Harrington, B. J., Prof., M.A., Ph.D., McGill University, Montreal, Canada
1896		Harrington, William, 9, Edgehill-terrace, Bransby, Whitehaven
1881		Harrington, William Bury, Leeview, Montenotte, Cork
1896		Harris, Frederick William, Sanitary Chambers, Glasgow
1893		Harris, Harold, The Birmingham Metals and Munitions Co., Ltd., Ammunition Factory, Streetly, nr. Sutton Coldfield, Birmingham
1895		Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia
1894		Harris, Sydney Walters, Devon House, Walter-road, Swansea
1878		‖Harris, Thomas Frederick, B.Sc. (Lond.), Waterford House, Aylsham, Norfolk
1895		Harris, Walter, M.A. (Cantab.), B.Sc. (Lond.), Ph.D. (Heidelberg), Sutherland Institute Technical School, Longton, Staffs.
1888		‖Harrison, Albert, Delamere, Grove-road, South Woodford, Essex
1894	Trans.	Harrison, Edward Frank, B.Sc. (Lond.), F.I.C., 55, Chancery-lane, W.C., and Langholm, Purley Oaks-road, S. Croydon
1883		‖Harrison, Hugh Erat, B.Sc. (Lond.), 28, Sussex-place, Regent's Park, N.W., and Faraday House, Charing Cross-road, W.C.
1901		Harrison, John Ansted, B.Sc. (Lond.), A.R.C.S., Brayton House, Wellington-row, Whitehaven
1888		Harrison, John Burchmore, C.M.G., M.A. (Cantab), F.I.C., Government Laboratory, George Town, Demerara, British Guiana
1902		Harrison, Walter Ernest, 15, Lansdowne-road, Handsworth Birmingham

Date of Election.			
1876	Trans.		Harrow, George Harrow Unwin, Ph.D. (Würzburg), F.I.C., Messrs. Allsopp and Sons' Brewery, Burton-on-Trent
1901			Harry, Frederick Thomas, 106, Sandmere-road, Clapham Common, S.W.
1906			Hart, Alfred, M.A., B.Sc. (Melbourne), Norman-avenue, Hawksburn, Victoria, Australia
1886			Hart, Bertram Harvey, The Elms, Old Charlton, Kent, S.E.
1869			‖Hart, Frederic William, Holly House, 96, Stoke Newington-road, N.
1900			Hart, Herbert William, 5, Cambridge-road, Ansdell, Lytham, Lancs.
1891			Hart, William Beamont, F.I.C., Laboratory, 8, Exchange-street, Manchester
1882			Hartley, Arthur, The Brewery, Emsworth, Hants.
1897			Hartley, Ernald George Justinian, B.A. (Oxon.), The Bungalow, Foxcombe Hill, near Oxford
1899	Trans.		Hartley, Harold Brewer, B.A. (Oxon.), Balliol College, Oxford
1897			Hartley, Thomas, B.Sc. (Lond.), F.I.C., Swindon and North Wilts. Technical School, Swindon
1866	Trans.	C. 1877-80 V.P. 90-3	†Hartley, Walter Noël, Prof., D.Sc. (R.U.I.), F.R.S., F.I.C., Royal College of Science, St. Stephen's-green, East, and 36, Waterloo-road, Dublin
1890	Trans.		Hartog, Philip Joseph, B.Sc. (Lond. and Vict.), 22, Brondesbury-villas, N.W.
1900	Trans.		Hart-Smith, James, A.R.C.S., F.I.C., 4, Grafton-mansions, Venn-street, Clapham, S.W.
1900	Trans.		Harvey, Alfred William, 13, Pendrell-road, St. Catherine's-park, Hatcham, S.E.
1885			Harvey, Ernest William, A.R.S.M., Stoneleigh, 23, Grove-road, Clapham Park, S.W.
1881			Harvey, Sidney, F.I.C., Canterbury
1894			Harvey, William Pellew, 31, Walbrook, E.C.
1894			Hatfield, John Adams, F.I.C., c/o Messrs. J. Lysaght, Ltd., Orb Iron Works, Newport, Mon.
1892			Hatton, William Percy, c/o Messrs. W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred Edward, M.D. (Brussels), L.R.C.P. (Edin.), 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, Edward, D.Sc. (Vict.), Sunnyside, Norman-road, Runcorn, Cheshire
1898			Haworth, John, 17, Knaresboro'-road, Millhouses, near Sheffield
1905	Trans.		Hawthorne, John, 7, Roseneath-villas, Military-road, Cork

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† Longstaff Medallist, 1906.

Date of Election.			
1905			Hayman, Jack Vernon Johnson, c/o Messrs. Robert Stephenson and Son, Ltd., Burwell, Cambs.
1900			Haynes, James Herbert, B.Sc. (Vict.), Sennen, 65, Kennington-avenue, Ashley Down, Bristol
1906			Hayworth, William Prince, 119, Clapton Common, N.E.
1903			Heasman, Harold Montague, 2, Broadway, Westminster, S.W.
1891			Heath, John William, 1, Carlyle-square, Chelsea, S.W.
1898			Heaton, John, Southcliffe, Roker, Sunderland
1902			Heaton, Noël, B.Sc. (Lond.), 20, Baker-road, Harlesden, N.W.
1906	Trans.		Hedley, Edgar Percy, A.R.C.S.I., 6, Royal-terrace-west, Kingstown, Co. Dublin
1899			Hedley, George Ward, M.A. (Oxon.), 2, St. Luke's-terrace, Cheltenham
1905			Heely, Frederick William, 10, Yarborough-street, Grimsby
1876		C. 1895-9	Hehner, Otto, F.I.C., 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D. (Heidelberg), A.R.S.M., F.I.C., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, I.S.O., F.I.C., Simonstone, 27, Hammelton-road, Bromley, Kent
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, James William, 3, Tavistock-road, Croydon
1899			Hembrough, James, A.R.C.S., A.I.C., 7, Park-view, Beeston-hill, Leeds
1900			Hemingway, Frank Christian Richard, 133, Front-street, New York City, U.S.A.
1898	Trans.		Hemmy, Arthur Stanley, Prof., B.A. (Cantab.), M.Sc. (Melbourne), Government College, Lahore, India
1885	Trans.		‖Henderson, George Gerald, Prof., M.A., D.Sc. (Glasgow), F.I.C., The Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, Ph.D. (München), B.Sc. (St. Andrews), c/o Horlick's Malted Milk Co., Racine, Wisconsin, U.S.A.
1905			Henderson, James Alexander Russell, Prof., B.Sc. (Glas.), Chihli Provincial College, Paotingfu, North China
1900	Trans.		Henderson, John Brownlie, F.I.C., Government Analyst, Brisbane, Queensland
1892			Hendrick, James, B.Sc. (Lond.), F.I.C., Marischal College, Aberdeen
1903			Hendrickson, Arthur V., The Gas Works, Lower Sydenham, S.E.
1901			‖Henley, The Hon. Francis Robert, M.A. (Oxon.), A.I.C., 9, Beaufort-gardens, S.W.
1905			Hennings, Carl Richard, Ph.D. (Freiburg), 19, St. Dunstan's-hill, E.C.

Date of Election.			
1899	Trans.		Henry, Thomas Anderson, D.Sc. (Lond.), 70, Doneraile-street, Fulham, S.W.
1905	Trans.		Henstock, Herbert, B.Sc. (Vict.), Ph.D. (Zürich), The University, Manchester
1904			Henzell, Archie Willoughby, Tintagel, Rooksmead-road, Sunbury-on-Thames
1895			Heriot, Thomas Hawkins Percy, 37, Church-crescent, Muswell Hill, N.
1871			Herman, Douglas, F.I.C., Rainhill, Lancs.
1876	Trans.	C. 1892-3	Heron, John, B.E. (R.U.I.), F.I.C., 110, Fenchurch-street, E.C.
1906			Herty, Charles Holmes, Prof., Ph.D. (Johns Hopkins), Ph.B. (Georgia), University of North Carolina, Chapel Hill, N.C., U.S.A.
1905			Hetherington, Arthur Lonsdale, B.A. (Cantab.), Government Collegiate School, Rangoon, Burma
1892	Trans.	C. 1903-05	Hewitt, John Theodore, M.A. (Cantab.), D.Sc. (Lond.), Ph.D. (Heidelberg), 7, The Avenue, Surbiton, Surrey
1900			Hewitt, Samuel, 51, Dover-street, Norwich
1892			Hewlett, John Cooke, 35–42, Charlotte-street, Great Eastern-street, E.C.
1883	Trans.	C. 1897-1901.	‖Heycock, Charles Thomas, M.A. (Cantab.), F.R.S., 24, Fitzwilliam-street, Cambridge
1890			Heywood, Joseph Hill, 231, Drake-street, Rochdale
1848			Heywood, John Sharp Cromartie, Export Department, Storer's Wharf, Poplar, E.
1876	Trans.		Hibbert, Walter, F.I.C., 144, Walm-lane, Willesden Green, N.W.
1881			‖Hiddingh, Michael, Newlands, near Capetown, South Africa
1905			Higgins, John Michael, 39, Queen-street, Melbourne, Australia
1901			Higgs, Henry Herbert, B.Sc. (Lond.), Ivanhoe, Highbridge-road, Wylde-green, Birmingham
1894			Higgs, Martin Stanger, Southern Main Reef Estates, Ltd., Mine Office, Venterskroon, Transvaal, South Africa
1882			‖Hill, Alexander, Merrylee, Northwood, Middlesex
1896	Trans.		Hill, Arthur Croft, M.A., M.D. and B.S. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 169, Cromwell-road, S.W.
1906	Trans.		Hill, Arthur Edwin, 143, Fordwych-road, Brondesbury, N.W.
1896			‖Hill, Charles Alexander, B.Sc. (Lond.), F.I.C., 15, Brunswick-gardens, Kensington, W.
1896	Trans.		Hill, Ernest George, Prof., B.A. (Oxon.), Muir College, Allahabad, India
1905			Hill, William Basil, Eastfield, Stockton-lane, York
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, S.W.
1892			‖Hills, Harold Fletcher, Commercial Gas Works, Stepney, E.
1906	Trans.		Hills, James Stuart, A.I.C., 225, Oxford-street, W.

Date of Election.			
1898			Hills, Thomas Herbert, 6, Eliot Park, Blackheath, S.E.
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, John William, A.R.S.M., Royal Mint, Bangkok, Siam
1903			Hindmarsh, Leonard King, M.A. (Oxon.), Chepstow House, Oxford-road, Wakefield
1900			Hinks, Percy John, A.R.C.S., F.I.C., Woodstock, Beaconsfield-road, Blackheath, S.E.
1894			Hirsch, Charles Theodore William, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Charlinch, Rectory-road, Woolwich, S.E.
1870			Hislop, George Robertson, Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, Robert Findlay, Craigielea, Paisley
1883			‖Hobbs, Bedo, Lamb Brewery, Chiswick, W.
1901			Hobson, Edwin, Howdendyke, Howden, Yorks.
1905			Hobsbaum, Isaac Berkwood, 79, Claremont-road, Forest-gate, E.
1884			Hodges, Herbert John, 224, The Rye, Peckham, S.E.
1882	Trans.		‖Hodgkin, John, F.I.C., 97, Hamlet-gardens-mansions, Ravenscourt Park, W.
1879	Trans.	C. 1883-5	Hodgkinson, William Richard Eaton, Prof., Ph.D. (Würzburg), F.I.C., 18, Gleniuce-road, Blackheath, S.E.
1886			Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, Harry McAlpin, Foxhill Bank Print Works, Church near Accrington
1873			‖Hodgson, Henry Tylston, M.A. (Cantab.), Harpenden, Herts.
1904			Hodgson, Thomas Reginald, B.A. (Cantab.), 21, Framfield-road, Highbury, N.
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D. (Paris), 62, Champs Elysées, Paris
1904			Hoit, Alfred Henry, 4, Montgomerie-road, Southsea
1876			Holcroft, Harold, M.A. (Cantab.), Parkdale, Wolverhampton
1901			Holdcroft, George Frederick, 16, De Gray-street, Beverley-road, Hull
1885			Holgate, Thomas, 5, Victoria-street, Westminster, S.W.
1876			Holland, Philip, F.I.C., 22, Taviton-street, Gordon-square, W.C.
1902			Hollingworth, David Vincent, Gas Offices, Bloom-street, Salford
1905			Hollins, Cecil, 137, Firs-lane, Leigh, Lancs.
1891			Holloman, Frederick Richard, Liston-street, Plaistow, E.
1886			Holloway, George Thomas, A.R.C.S., F.I.C., 57 and 58, Chancery-lane, W.C.
1895			Holme, Arthur Edward, M.A. (Oxon.), The Wheelwright Grammar School, Dewsbury
1897	Trans.		Holmes, John, F.I.C., Government Laboratory, Clement's Inn Passage, W.C.

Date of Election.			
1898	Trans.		Holroyd, George William Fraser, B.A. (Oxon.), 20, Creffield-road, Ealing, W.
1902	Trans.		‖Holt, Alfred, jun., B.A. (Cantab.), Crofton, Aigburth, Liverpool
1893			Holthouse, Harold Bertram, 12, Melton-grove, West Bridgford, Notts.
1898			Homfray, David, B.Sc. (Lond.), F.I.C., The Ings, Misterton, near Gainsborough
1878			Hooker, Ayerst Henham, F.I.C., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel Cox, Ph.D., 4422, Chestnut-street, Philadelphia, U.S.A.
1883			‖Hooper, David, F.I.C., Curator, Economic and Art Section, Indian Museum, 1, Sudder-street, Calcutta, India
1888			‖Hooper, Egbert Grant, F.I.C., 16, Royal-avenue, Sloane-square, S.W.
1891			‖Hooper, Ernest Frederick, Wear Fuel Works, South Dock, Sunderland
1906			Hopkins, Frederick Gowland, M.A. (Cantab.), M.B. and D.Sc. (Lond.), F.R.S., F.I.C., Stafford House, Wordsworth-grove, Newnham, Cambridge
1902			Hopwood, Arthur, A.R.C.S., A.I.C., 49, Stanley-street, Tunstall, Stoke-on-Trent
1904			Horn, George Mathieson, Ivylands, Epping, Essex
1894			‖Hornby, Richard, M.A. (Oxon.), Haileybury College, Hertford
1904			Horrod, George William Thomas, 294, Brixton Hill, S.W.
1897			Horseman, James Walter, County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901	Proc.		Horton, Edward, 8, Orford-street, Chelsea, S.W.
1892			Horwill, Edgar Edward C., 6, Devereux-road, New Wandsworth, S.W.
1902			Hosking, Arthur Francis, c/o The Aruba Gold Concession, Ltd., Aruba Island, Dutch West Indies, viâ Curaçao
1886			‖Hoskins, Arthur Percy, F.I.C., Clonlee, Rosetta-park, Belfast
1871			Houlder, William Washington, North Hyde House, Southall
1901			Houldershaw, Arthur, 4, Beacon-street, Low Fell, Gateshead-on-Tyne
1887	Proc.		Houlding, William, B.Sc., Arisaig, Aigburth Drive, Liverpool
1896			Howard, Albert, The Agricultural Research Institute, Pusa, Bengal, India
1882			‖Howard, Alfred Gravely, Burnt House, Chigwell, Essex
1901			Howard, Bernard Farnborough, A.I.C., Devon House, Buckhurst Hill, Essex
1870		C. 1875-9, 83-5, 98-1902. V.P. 1886-9, 1903-06	‖Howard, David, J.P., F.I.C., Devon House, Buckhurst Hill, Essex

Date of Election.		
1887	Trans.	‖Howard, David Lloyd, Little Friday Hill, Chingford, Essex
1889		Howard, George William, Calverley, Tunbridge Wells
1875		Howard, Thomas, F.I.C., 50, Ellington-street, Liverpool-road, N.
1903		Howarth, John George, Danes Dyke, Lowther-road, Bournemouth
1882		Howe, James Lewis, Prof., M.D. (Louisville), Ph.D. (Göttingen), B.A. (Amherst), Washington and Lee University, Lexington, Virginia, U.S.A.
1880		Howell, Reginald, 95A, Southwark-street, S.E.
1905		Howgate, James Henry, B.A. (Lond.), The Grammar School, Huntingdon
1876		Howie, William Lamond, Hanover Lodge, West Hill, Harrow
1903		Howorth, Franklin Wise, 46, Lincoln's Inn Fields, W.C.
1889		‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889		Hoyles, Henry Richardson, 10, Fore-street, Wellington, Somerset
1871		‖Hudleston, Wilfrid Hudleston, M.A. (Oxon.), F.R.S., 8, Stanhope-gardens, S.W.
1900		Hudson, Edmund Foster, B.A. (Cantab.), Churcher's College, Petersfield, Hants.
1878		Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899		Hübner, Julius, F.I.C., Ash-villa, Cheadle Hulme, Cheshire
1901		Hughes, Edward, Rev. Canon, The Rectory, Barmouth
1903		Hughes, Edwin Reginald, 106, Queen Victoria-street, E.C.
1894	Trans.	Hughes, Frank, c/o Khedivial Agricultural Society, P.O. Box 63, Cairo, Egypt
1880	Trans.	Hughes, George Henry, 155, Fenchurch-street, E.C.
1868		Hughes, John, F.I.C., Analytical Laboratory, 79, Mark-lane, E.C.
1906		Hughes, John Gerard, 2, Canute-road, Southampton
1896		Hughes, Joshua Arthur, 1, Bridewell-street, Bristol
1885		Hughes, Theophilus Vaughan, A.R.S.M., F.I.C., 26, Barnsley-road, Edgbaston, Birmingham
1882		Hughes, Thomas, F.I.C., Borough Analyst's Office, 31, Loudoun-square, Cardiff
1904		Hulme, John, 5, Duke-street, Macclesfield
1883		Humphrys, Norton Henry, 4, The Paragon, Wilton-road, Salisbury
1899		Hunter, Archibald Glen Kidston-, Public Analyst, Freemantle, West Australia
1883		Hunter, John, F.I.C., 37, Chambers-street, Edinburgh
1885		Hunter, Matthew, M.A. (Oxon.), Cowside, Settle, Yorks.
1878		Huntington, Alfred Kirby, Prof., A.R.S.M., F.I.C., Metallurgical Laboratory, King's College, Strand, W.C.

Date of Election.		
1893	Trans.	Huntly, George Nevill, B.Sc. (Lond.), A.R.C.S., F.I.C., 96, Gower-street, W.C., and 56, Sheen-road, Richmond
1902	Trans.	Hurtley, William Holdsworth, D.Sc. (Lond.), St. Bartholomew's Hospital, E.C.
1861		Huskisson, Henry Owen, F.I.C., 5, Gordon-square, W.C.
1900		Hutchin, Henry William, Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, M.A. (Cantab.), B.Sc., Bryn-y-Mor, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A. (Cantab.), Ph.D. (Würzburg), Pembroke College, Cambridge
1884		‖Hutchinson, Christopher Clarke, F.I.C., 13, The Boltons, South Kensington, S.W.
1901		Hutton, Robert Salmon, D.Sc. (Vict.), The University, Manchester
1903		Huyin, Moung Tha, B.A. (Calcutta), Barrister-at-Law, Moulmein, Burma
1901		Hyder, Alfred James, 22, Gunton-road, Upper Clapton, N.E.
1900		‖Ichioka, Tajiro, Prof., 19, Maruyama Shinmachi, Hongo, Tokio, Japan
1888		Idris, Thomas Howell Williams, M.P., 110, Pratt-street, Camden Town, N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1889	Trans.	‖Ingle, Herbert, F.I.C., Government Agricultural Chemist, Pretoria, Transvaal, South Africa
1904	Trans.	Inglis, John Kenneth Harold, M.A., D.Sc. (Edin.), B.Sc. (N.Z.), University College, Reading
1901		Ingram, Beresford, William Ellis Endowed School, Gospel Oak, N.W.
1897	Trans.	Innes, William Ross, Ph.D. (Heidelberg), D.Sc. (Vict.), F.I.C., 6, Griffiths-road, Wimbledon, S.W.
1901		‖Ionides, Stephen Archigenes, 23, Second-avenue, Hove, Sussex
1906		‖Irving, Henry Carlyle, B.A. (Oxon.), 14, Heath Hurst-road, Hampstead, N.W.
1883		‖Irwin, Wilfred, Inglehurst, Higher-lane, Stand, Manchester
1892		‖Isaac, John F. V., M.A. (Oxon.), Barton Court, Abingdon, Berks
1885		Ivatt, Albert, M.A. (Cantab.), The Engadine, Histon, Cambridge
1905		Jack, Maurice Brooks, 66, Burma-road, Clissold Park, N.
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex

Date of Election.			
1883			‖Jackson, Alfred Henrick, Prof., B.Sc. (Vict.), M.Inst.E.E., The Electrical Engineering School, 349, Collins-street, Melbourne, Australia
1894	Trans.		Jackson, David Hamilton, M.A. and B.Sc. (N.Z.), Ph.D. (Heidelberg), 73, Parliament Hill, N.W.
1882			Jackson, Edward, F.I.C., Raven's Clift, Oxford-road, Moseley, Birmingham
1900	Trans.		Jackson, Henry, M.A. (Cantab.), Downing College, Cambridge
1884	Trans.		Jackson, Herbert, Prof., F.I.C., Chemical Laboratory, King's College, Strand, W.C.
1881			‖Jackson, Ransford Valentine, B.A. (Oxon.), c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			Jackson, Samuel, A.R.C.S., F.I.C., Edzell, Park-avenue, Knaresborough, Yorks.
1902			Jackson, William Brannan, Glengowan, Caldercruix, N.B.
1903			Jackson, William Henry, 73, Church-street, West Hartlepool
1887			‖Jadhava, Khasberao B., M.R.A.C., Nawasari, Bombay Presidency, India
1900			Jaffé, Adolf, 8, Leyburn-grove, Shipley, Yorks.
1878	Trans.		Jago, William, F.I.C., 3, Crown Office-row, Temple, E.C., and 17, Wilbury-avenue, Hove, Sussex
1895			James, Alfred, 2, Broad-street-place, E.C.
1904	Trans.		James, Thomas Campbell, B.A. (Cantab.), B.Sc. (Wales), University College of Wales, Aberystwith
1904			James, Walter Richmond, 49, Wednesfield-road, Wolverhampton
1878			Jameson, Alexander, 134, Castellain-mansions, Sutherland-avenue, W.
1901			Jamieson, James Sprunt, F.I.C., Government Laboratory, Durban, Natal
1879	Trans.	C.1882-5 F.S. 85-91 V.P.95-9	†‖Japp, Francis Robert, Prof., M.A., Hon. LL.D. (St. Andrews), F.R.S., F.I.C., The University, Aberdeen
1902			Jardin, David Smith, A.R.C.S., F.I.C., Rathgar House, Rathgar, Co. Dublin
1902			Jardine, Douglas Kennedy, B.Sc. (Vict.), c/o Daily Chronicle Office, Georgetown, Demerara, British Guiana
1882			Jarmay, Gustav, F.I.C., Hartford Lodge, Hartford, Cheshire
1905			Jarrard, William John, B.Sc. (Lond.), A.R.C.S., The University, Sheffield
1898			Jarvis, George Arthur, The Shrubbery, Snedshill, Wellington, Salop
1898			Jee, Edwin Charles, D.Sc. (Lond.), F.I.C., 39, Pepys-road, New Cross, S.E.
1896	Proc.		Jeffers, Ernest Haynes, 87, Kyrle-road, West-side, Clapham Common, S.W.

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† Longstaff Medallist, 1891.

Date of Election.		
1901	Proc.	Jemmett, William Henry Coutts, M.A. (Cantab.), Tintern, Gap-road, Wimbledon, S.W.
1891	Trans.	Jenkins, Henry Charles, A.R.S.M., Assoc. M. Inst. C.E., Cusgarne, Perranwell, Cornwall
1904		Jenkins, Herbert, 15, Old Bond-street, Bath
1892		‖Jenkins, John H. B., Chemical Laboratory, Great Eastern Railway Works, Stratford, E.
1906	Trans.	Jenkinson, Ernest Arthur, Dauntsey Agricultural School, West Lavington, Wilts.
1894		Jenks, Robert Leonard, A.C.G.I., F.I.C., The Poplars, Penketh, near Warrington
1903		Jennings, Walter Ernest, 8, Rawdon-terrace, Ashby-de-la-Zouch
1894		Jennison, Francis Herbert, F.I.C., 26, Derby-crescent, Kelvinside, near Glasgow
1897	Trans.	‖Jerdan, David Smiles, M.A. (Glas.), D.Sc. (Vict.), Ph.D. (Heidelberg), Temora, Colinton, Midlothian.
1898		Jessop, Samuel Morton, 84, Horbury-road, Wakefield
1879		Jewson, Francis Albert Bowen, F.I.C., 19A, Devonshire-place, Brighton
1901		Johnson, Charles Harold, M.D., C.M., F.R.C.S. and M.R.C.P. (Edin.), Beaumont, Northcote, Melbourne, Australia
1895		Johnson, Frederick Edward, Holly House, Cottingham, Hull
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), 5, Avington-grove, Penge, S.E.
1883		Johnson, James Edward, F.I.C., 40, Idmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1904		Johnson, John Richard, 86, Waldegrave-road, Preston-park, Brighton
1897		Johnson, Otis C., Prof., 730, Thayer-street, Ann Arbor, Mich., U.S.A.
1866		‖Johnson, Samuel Henry, The Warren-hill, Loughton, Essex
1904		Johnston, John Haslam, M.Sc. (Vict.), F.I.C., Public Offices, Hampton, Middlesex
1896		Johnstone, James, F.I.C., Braehead, Parkhill, Rutherglen
1892		Johnstone, William George, c/o Thomas Manwell, Esq., 8, Great Winchester-street, E.C.
1901	Trans.	Jollyman, Walter Henry, F.I.C., P.O. Box 3782, and Government Laboratory, P.O. Box 1080, Johannesburg, Transvaal, South Africa
1903		Jones, Alfred Owen, c/o Messrs. Carr & Co., Caldewgate, Carlisle
1905		Jones, Bernard Mouat, B.A. (Oxon.), Prof., Government College, Lahore, India.
1898		Jones, Edward, B.Sc. (Lond.), F.I.C., 15, Macaulay-road, Clapham, S.W.

Date of Election.			
1905			Jones, Edward Towyn, B.Sc.,(Wales), 17, Bloomsbury-square, W.C.
1871	Trans.		Jones, Edward William Taylor, F.I.C., The Oaklands, and 10, Victoria-street, Wolverhampton
1873	Trans.		Jones, Francis, M.Sc. (Man.), F.R.S.E., Beaufort House, Alexandra-park, Manchester
1894			‖Jones, George Cecil, A.C.G.I., F.I.C., Stour-villa, Mistley, Essex
1876	Trans.		‖Jones, Henry Chapman, F.I.C., Royal College of Science, South Kensington, S.W.
1893			Jones, Hedley Gordon, F.I.C., 32, Beechhill-road, Eltham, S.E.
1900	Trans.		Jones, Humphrey Owen, M.A. (Cantab.), D.Sc. (Lond. and Wales), Clare College, Cambridge
1878			Jones, Henry Williams, Spencer-park, Coventry
1904			Jones, Horace Francis, 7, Marlborough-avenue, Reading
1890			Jones, John Archyll, B.Sc. (Lond.), Reethville, Park-road, West Hartlepool
1901			Jones, John Lloyd Thomas, Major, I.M.S., M.B. (Dun.), M.R.C.S. (Eng.), D.P.H. (Cantab.), H.M.'s Mint, and Byculla Club, Bombay
1892	Trans.		Jones, Lionel Manfred, B.Sc. (Lond.), Municipal Technical School, Suffolk-street, Birmingham
1899			Jones, Lander William, A.B. (Williams Coll.), Ph.D. (Chicago), University of Chicago, Chicago, Ill., U.S.A.
1906			Jones, Llewelyn Thomas, B.Sc. (Wales), 22, Ashfield-terrace, Bingley, Yorks
1891			Jones, Moses William, Greystonedale, Kensington-hill, Brislington, Bristol
1905			Jones, Percy Walter, Toowong, Brisbane, Queensland
1896			Jones, Robert Haslewood, 88, Norwood-road, London, S.E.
1901			Jones, Robert Henry, M.Sc. (Vict.), The Harris Institute, Preston
1898			Jones, Thomas Hill-, Invicta Mills, Bow-common-lane, E.
1905			Jones, Tudor Foulkes, B.Sc. (Wales), Chatham House, Ramsgate
1904			Jones, William App., A.M. (North Carolina), Ph.D. (Baltimore), c/o The Boston Artificial Leather Co., Ludlow and Canal-street, Stamford, Conn., U.S.A.
1906			Jones, William Henry Matthews, Leyden Villa, Chester.
1904	Trans.		Joseph, Alfred Francis, A.R.C.S., Royal College, Colombo, Ceylon
1893	Trans.	C. 1906-	Jowett, Hooper Albert Dickinson, D.Sc. (Lond.), Wansfell, Church-avenue, Sidcup, Kent
1891			Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900			Joyce, Thomas Goode, B.Sc. (Lond.), F.I.C., 41, Britannia-row, Islington, N.

Date of Election.			
1893			Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.		Kawakita, Michitada, Engineering College, Tokio, Japan
1905	Trans.		Kay, Sydney Alexander, D.Sc. (St. Andrews), United College, St. Andrews, N.B.
1881	Trans.		Kay, William Edward, Marple Lodge, Marple, Cheshire
1889			Kaye, James Robert, M.B. and C.M. (Glas.), Medical Officer of Health, West Riding of Yorkshire, Wakefield
1886	Trans.	C. 1903-5	‖Keane, Charles Alexander, Ph.D. (Erlangen), M.Sc. (Vict.), F.I.C., The Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1883			‖Keeling, Frank, c/o David Stevenson Brewing Co., 521, Tenth-avenue, New York, U.S.A.
1882			‖Keen, Austin, Cefn Llys, Bentley-road, Cambridge
1894			‖Kellas, Alexander Mitchell, B.Sc. (Lond.), 2, St. Mark's-square, Regent's Park, N.W., and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874			Kellner, William, Ph.D. (Göttingen), F.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E., and 135, Victoria-road, Old Charlton, Kent
1897			Kelly, Charles, The Technical School, Darwen, Lancs.
1867			‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882			‖Kemp, William Joel, F.I.C., Caerthillian, Sidcup, Kent
1903			Kemp-Welch, Maurice, B.A. (Cantab.), Parkstone, Weybridge, Surrey
1884			Kendall, George Frederic, B.A. (Cantab.), The Hollies, Stratford-on-Avon
1874			Kendall, James Alfred, F.I.C., Lonesome Chemical Works, Streatham Common, S.W.
1896			‖Kennicott, Cass Langdon, Chicago Heights, Illinois, U.S.A.
1903			Kent, Thomas Oliver, 89, Loughboro'-park, Brixton, S.W.
1889			Kenwood, Henry Richard, M.B. and C.M. (Edin.), L.R.C.P. (Lond.), Wadhurst, 150, Bethune-road, Stamford Hill, N.
1895			Kenyon, Richard Ernest, M.Sc. (Vict.), Municipal Technical School, Sutton Coldfield
1903			Kerr, James Stewart, A.R.C.S., A.I.C., Methodist College, Belfast
1883			Kerry, William Hugh Rubens, The Sycamores, Windermere
1900			Kershaw, James Henry, Corporation Sewage Works, Dalton, Rotherham, Yorks.
1901			Kettle, James David, B.Sc. (Lond.), 1, Vardens-road, St. John's-hill, Battersea, S.W.
1902			Kewley, James, B.A. (Cantab.), King William's College, Castletown, Isle of Man
1901			Kiddell, Christopher George, B.A. (Lond.), Hadley Highstone, Barnet, Herts.

Date of Election.			
1903			Kielty, John Joseph, Nethersgate, Cairo-road, Walthamstow, Essex
1905			Killby, Leonard Gibbes, B.A. (Oxon.), 10, Aberdeen-park, Highbury, N.
1900			Kilner, George Washington, M.A. (Lond.), 4, Melrose-villas, Church-end, Finchley, N.
1884			Kilpatrick, William Stirling, 6, Colebrook-street, Hillhead, Glasgow
1903			Kin, Thein, B.A. (Cal.), Chemical Examiner's Office, Rangoon, Lower Burma, India
1872	Trans.	C. 1887-92	‖Kinch, Edward, Prof., F.I.C., Royal Agricultural College, Cirencester
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1902			‖King, Frank Eustace, B.Sc. (Lond.), A.I.C., Woodbury, Polworth-road, Streatham, S.W.
1903			King, Frank William George, 15, Almond-road, Tottenham, N.
1897			King, Herbert, M.Sc. (Vict.), F.I.C., 8, Avenue-road, Scarborough
1876			King, John Falconer, F.I.C., Laboratory of City Analyst, 20, Chambers-street, Edinburgh
1902			King, Sidney Isaac, 1, Russell-villas, Strawberry Hill, Middlesex
1895			Kingdon, George Holman, M.A. (Oxon.), c/o Messrs. Crosfield, Limited, Warrington, and Ivy Lodge, Froghall, Warrington
1872	Trans.		‖Kingzett, Charles Thomas, F.I.C., 1, Hornton-street, Kensington, W.
1895			‖Kinnicut, Leonard Parker, Prof., Sc.D. (Harvard), Worcester Polytechnic Institute, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	‖Kipping, Frederic Stanley, Prof., D.Sc. (Lond.), Ph.D. (Munich), F.R.S., F.I.C., University College, Nottingham
1886			Kirby, Herbert Edward, St. Margaret's-mansions, Victoria-street, S.W.
1890			Kirk, Oliver, 7, Banklands, Workington
1895			‖Kirkaldy, Patrick Henry, F.I.C., Chemical Department, King's College, W.C.
1903			Kirkby, William, Winster House, Thornfield-road, Heaton Moor, Stockport
1889			Kitchin, John, The Middlesex Hospital, W.C.
1888			‖Knaggs, Alfred Battye, 37, Mannville-terrace, Bradford
1889			Knight, Frederick Charles, Boston and Colorado Smelting Co., Argo, Colorado, U.S.A.
1903			Knight, Harley Fancut, Ledbury, 64, Amhurst-park, Stamford Hill, N.
1894			Knight, James, M.A., D.Sc. (Glas.), St. James's Public School, Calton, Glasgow

Date of Election.			
1896			Knight, John Burnett, Bushwood, Wanstead, Essex
1894			Knight, William Albert, Sexey's Trade School, Bruton, Somerset
1878			Knights, James West, F.I.C., County Laboratory, Cambridge
1879			Knowles, Joshua, Stormer-hill, Tottington, Bury
1892			Knowles, Thomas Torrens, M.A. (Cantab.), c/o G. D. Killey, Esq., Bentuther, Waterloo, Liverpool
1864			Knox, George Walter, B.Sc. (Lond.), 16, Finsbury-circus, E.C.
1873			Koch, Walter Edward, M.A., P.O. Box 718, El Paso, Texas, U.S.A.
1887	Trans.		Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1904			Komppa, Gustav, Prof., Ph.D., Polytechnik, Helsingfors, Finland
1885			Koningh, Leonard de, F.I.C., 4, St. Martin's-road, Stockwell, S.W.
1892			Krause, Georg, Prof. Dr., Cöthen (Anhalt), Germany
1859	Trans.		Kynaston, Josiah Wyckliffe, F.I.C., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900			Kynaston, William Charles Robert, 9, Harland-road, Higher Tranmere, Birkenhead
1903			Laing, John, F.I.C., 5, Scone-gardens, Piershill, Edinburgh
1893			Lamb, Edmund George, M.A., Borden Wood, Liphook, Hants.
1900			Lamb, Morris Charles, Herold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.		‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893			Lambert, Wesley J., Chemical Laboratory, Royal Gun Factory, Woolwich, S.E.
1903			Lamplough, Francis Edward Everard, B.A. (Cantab.), Trinity College, Cambridge
1877			Lancaster, William James, F.R.C.S., Pine Crest, Barnt Green, Worcs.
1902			Landau, A. Lionel, P.O., Prestea Block A, Gold Mining Co., Tarquah, West Africa
1900	Trans.		Lander, George Druce, D.Sc. (Lond. and St. Andrews), F.I.C., Royal Veterinary College, Camden Town, N.W.
1897	Trans.		Lang, William Robert, Prof., D.Sc. (Glasgow), F.I.C., The University, Toronto, Canada
1899			Lange, Ernest Frederick Stephen, Fairholm, Willow Bank. Fallowfield, Manchester
1885			Langer, Charles, Ph.D. (Zürich), Ynyspenllwch, Clydach, R.S.O., Glamorganshire
1891			‖Langham, Edgar Norman, Rev., M.A. (Cantab.), Head Master, Rastrick Grammar School, Brighouse
1894	Trans.	C. 1904-	Lapworth, Arthur, D.Sc. (Lond.), F.I.C., The Goldsmiths' Institute, New Cross, S.E.

Date of Election.		
1901	Proc.	Larter, Alfred Tabois, B.Sc. (Lond.), Coolavin, St. Stephen's-road, Hounslow, Middlesex
1883		Lascelles, Brian Piers, M.A. (Oxon.), Longridge, High-street, Harrow-on-the-Hill
1880		Last, Frank Bernard, F.I.C., Maes-y-Mor, Eaton-grove, Swansea
1901		Lattey, Robert Tabor, Trinity College, Oxford
1906		Lattey, William Tabor, Corpus Christi College, Cambridge
1891	Trans.	Lauder, Alexander, D.Sc. (Edin.), Edinburgh and East of Scotland College of Agriculture, 13, George-square, Edinburgh
1904		Lauder, James Stanley, c/o B. Harvey, Esq., South Qu'Appelle, N.W.T., Assa., Canada
1886	Trans.	Laurie, Arthur Pillans, Principal, M.A. (Cantab.), D.Sc. (Edin.), F.R.S.E., The Heriot-Watt College, Edinburgh
1902		Lavelle, Selwyn Philip James, c/o Messrs. Mortimer and Co., Ltd., Driffield, East Yorks.
1876		‖Law, Channell, Ilsham Dene, Torquay
1905	Trans.	Law, Herbert Drake, B.Sc. (Lond.), Borough Polytechnic, 103, Borough-road, S.E.
1896		‖Law, Herbert Edward, Fairmont-building, San Francisco, Cal., U.S.A.
1890	Trans.	‖Law, Robert, F.I.C., The Royal Mint, Melbourne, Australia
1903		Lawrence, Henry William, c/o The Agricultural and Pastoral Food Co., Ltd., 12, Custom House Quay, Wellington, New Zealand
1900		Laws, Arthur Robert, 22, Belgrave-terrace, Newcastle-on-Tyne
1882		Laws, Joseph Parry, F.I.C., 2, Aigburth-vale, Liverpool
1890	Trans.	‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890		Lea, Arthur Sheridan, M.A., Sc.D. (Cantab.), F.R.S., Sunnyside Sidcup, Kent
1886		‖Leach, Walter, 21, St. Andrew's-place, Bradford
1902		Leader, George Herbert, Montego Bay Secondary School, Montego Bay, Jamaica
1894	Trans.	‖Lean, Bevan, B.A., D.Sc. (Lond.), Sidcot School, Winscombe, Somerset
1888		Lease, Frank Edward, Sapong Estate, Fort Birch, British North Borneo
1902		Leather, John Petty, 17, Carlton-road, Burnley, Lancs.
1891	Trans.	Leather, John Walter, Ph.D. (Freiburg), F.I.C., Agricultural Research Institute, Pusa, Bengal, India
1900		‖Leathes, John Beresford, M.A., M.B. and B.Ch. (Oxon.), F.R.C.S. (Eng.), 89, Albert Bridge-road, S.W.
1889		Ledingham, Laurence Napier, Govandale, Taptonville-crescent, Sheffield

Date of Election.		
1883		Lee, Herbert Cabry, The Conservative Club, St. James'-street, S.W.
1898		Lee, Harry Lancelot, 32, Manor Drive, Headingley, Leeds
1883		Lee, Robert Brewer, B.A., B.Sc. (Lond.), 6, Warwick-chambers, Pater-street, Kensington, W.
1897	Trans.	Lee, Theophilus Henry, 36, Rua do Ouvidor, Rio de Janeiro, Brazil
1905		Leech, Herbert Louis, c/o Messrs. Higginbotham and Co., Ltd., Springfield Print Works, McNeil-street, Glasgow
1891		Leeds, Frank Henley, F.I.C., 26, East-bank, Stamford Hill, N.
1905		Leek, William Henry, B.A. (Lond.), Elm View, Leigh, Lancs.
1899		Leeming, William Thomas, M.Sc. (Vict.), Simon Langton School, Canterbury
1873		Lees, Charles, Devonshire House, Bridlington Quay, Yorks.
1903	Trans.	Lees, Frederic Herbert, Avondale, Green-street-green-road, Dartford, Kent
1891		Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889		‖Legg, John Edmund, M.A. (Cantab.), F.I.C., Cae Rhys, Dorchester-road, Weymouth
1901		Lehmann, Adolf Ludwig Ferdinand, B.Sc. (Toronto), Ph.D. (Leipzig), Bangalore, Mysore, India
1891	Proc.	Leicester, James, Ph.D. (Erlangen), F.I.C., 17, Staverton-road, Oxford
1903		Leigh, Arthur Graham, jun., Chorcliff House, Chorley, Lancs.
1889		Leigh, Cecil, F.I.C., Birmingham Metal and Munitions Co., Ltd., Adderley Park Rolling Mills, Birmingham
1904		Le May, Percy Kent, 6, Lothair-villas, Hatfield, Herts.
1891		Lennox, Robert N., Morvah, Hartington-road, Chiswick, S.W.
1899		Leon, Arthur Alexander, 5, Bullingham-mansions, Pitt-street, Kensington, W.
1906	Trans.	Le Rossignol, Robert, B.Sc. (Lond.), A.I.C., 2, Caesarea-place, Jersey, Channel Islands
1904		Lessing, Rudolf, Ph.D. (Munich), c/o Gas Light and Coke Co., Tar Works, Beckton, E.
1902		Lessner, Charles B., Carril, Spain
1895	Trans.	|Le Sueur, Henry Rondel, D.Sc. (Lond.), F.I.C., St. Thomas's Hospital, S.E.
1896	Trans	Lethbridge, William Arthur Finch, B.A. (Oxon.), Moore's Hotel, Cork, Ireland
1899		Lett, Stephen Joshua, c/o Capt. A. N. Campbell, Missale Mines, Portugese Zambesia, *via* Cape Town, Salisbury and Fort Jamieson
1879		Letts, Edmund Albert, Prof., Hon. D.Sc. (R.U.I.), Ph.D. (Göttingen), F.I.C., Queen's College, Belfast

Date of Election.			
1904			Levy, Arthur Garfield, B.Sc. (Lond.), F.I.C., c/o B. Blount, Esq., F.I.C., 76, York-street, Westminster, S.W.
1903			Levy, Henry Wolff, 423B, Little Collins-street, Melbourne, Australia
1888	Trans.		Lewes, Vivian Byam, Prof., F.I.C., 19, Park-row, Greenwich, S.E.
1899	Trans.		Lewis, Edward Watkin, Hollycroft, Loughton, Essex
1901			Lewis, Ernest Alfred, 310, Dudley-road, Birmingham
1905			Lewis, Ernest Isaac, B.A. (Cantab.), B.Sc. (Lond.), Oundle School, Oundle
1903			Lewis, Harry Percy, 9, Calvert-terrace, Swansea
1894	Trans.		Lewis, William Henry, M.A. (Oxon.), F.I.C., 24, Wonford-road, Exeter
1869	Trans.		‖Lewis, William James, Prof., New Museums, Cambridge
1888	Trans.	C. 1902–03	‖Lewkowitsch, Julius, Ph.D. (Breslau), F.I.C., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, Theodore David, F.I.C., Chemical Works, Silvertown, E.
1896			Lidgey, Cecil Rudolf, 50a, Forest Hill-road, East Dulwich, S.E.
1900			Liebmann, Adolf, M.A., Ph.D. (Bonn), 16, Darley-avenue, West Didsbury, Manchester
1903			Linday, John Howard, c/o Messrs. John Robinson and Co., Ltd., Oil Seed Crushers, Redcliffe-parade, Bristol
1901			Linde, Harold Theodor Granville van der, 101, Tyndall-avenue, Toronto, Canada
1892			Lindley, Hubert Edward, Rose Villa, Pinner-road, Harrow
1899			Lindsey, Robert William, 14, Hilldrop-road, Camden-road, N.
1886	Trans.		Ling, Arthur Robert, F.I.C., Hazeldene, Kingston-road, New Malden, Surrey
1899			Linstead, Edward Flatman, 15, Station-avenue, Winchmore Hill, N.
1902			Liotard, Ernest, 2, Rue de France, Nice, France
1905			Lister, Joseph, B.Sc. (Lond.), A.R.C.S., 50, Portland-street, Lancaster
1853	Trans.	V.P. 1883-7 1898-1901	‖Liveing, George Downing, Prof., M.A. (Cantab.), Hon. Sc.D. (Dub.), F.R.S., F.I.C., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof. M.A. (Cantab.), Hon. LL.D. (Glas.), A.R.S.M., F.R.S., F.I.C., The University, Sydney, and The Octagon, St. Mark's-road, Darling Point, Sydney, N.S.W.
1903			Livesey, Charles Edwin Leonard, B.Sc. (Vict.), Stonyhurst College, Blackburn, Lancs.
1883			Livingston, William John, F.I.C., London County Council, Spring-gardens, S.W.
1880			‖Lloyd, Alfred, The Dome, Bognor, Sussex

Date of Election.		
1876	Trans.	Lloyd, Frederick James, F.I.C., Muscovy House, 6, Trinity-square, E.C.
1905		Lloyd, George Moss, M.A. (Vict.), M.Sc. (Liverpool), Homeland, Queen's-road, Rock Ferry, Cheshire.
1893		Lloyd, Herbert, Allegheny-avenue, and 19th-street, Philadelphia, U.S.A.
1896		Lloyd, Thomas Henry, c/o Messrs. Quibell Bros., Ltd., Newark-on-Trent
1900		Lockhart, Thomas Lamb, Glencairn Main Reef Gold Mining Co., Ltd., P.O. Box 231, Germiston, Transvaal, South Africa
1902		Lockitt, Charles Henry, B.A. (Lond.), Rectory Cottage, Solihull, Birmingham
1896		Lockwood, Thomas William, Heckmondwike, Yorks.
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1902		Logan, Thomas Stratford, The Colony, Ewell, Surrey
1884		London, John Edward, M.D. (Dun.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 62, Main-street, Georgetown, Demerara, West Indies
1872		‖Longstaff, George Blundell, M.A. and M.D. (Oxon.), F.R.C.P., (Lond.), M.R.C.S. (Eng.), Highlands, Putney Heath, S.W.
1904		Longstaff, James Patrick, B.Sc. (Edin.), 17, Fettes-row, Edinburgh
1873		‖Loram, Herbert Yabsley, F.I.C., 49, Buxton-road, Chingford, Essex
1878	Trans.	‖Louis, David Alexander, F.I.C., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward Gurley, Ph.D. (Columbia), 80, East 55th-street, New York, U.S.A.
1882		‖Lovibond, Thomas Watson, F.I.C., Hesleyside, Bellingham, R.S.O., Northumberland
1884		‖Low, Charles William, M.B. (Dun.), L.R.C.S. (Eng.), L.R.C.P. (Lond.), Stricklands, Stowmarket, Suffolk
1904	Trans.	Lowe, Frank Harold, M.Sc. (Vict.), South-Western Polytechnic, Manresa-road, Chelsea, S.W.
1878		‖Lowe, Walter Bezant, M.A. (Cantab.), Cae Carw, Llanfairfechan, North Wales
1876		Lowe, William Foulkes, A.R.S.M., F.I.C., 9, Hough-green, Chester
1898	Trans.	‖Lowry, Thomas Martin, D.Sc. (Lond.), 130, Horseferry-road, Westminster, S.W.
1901		Lowson, William, B.Sc. (Lond.), F.I.C., The University, Leeds
1899		Lucas, Alfred, F.I.C., Survey Department, Finance Ministry, Giza, Egypt
1905		Lucas, Edward William, F.I.C., 2, Hills-place, Oxford-street, W.
1902		Lucas, Harry, 1, St. Agnes'-place, Kennington Park, S.E.

Date of Election.		
1905		Luck, Alfred Courtenay, The Arsenal, Zarate, Argentina
1902	Trans.	Ludlam, Ernest Bowman, Hospitalstrasse 23, Kiel, Germany
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, South Africa, and Southville, Swansea
1877	Trans.	‖Luff, Arthur Pearson, M.D., B.Sc. and F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., 9, Queen Anne-street, Cavendish-square, W.
1890	Trans.	Lumsden, John Scott, D.Sc. (St. Andrews), Ph.D. (Munich), 9, Rosewood-terrace, West Park, Dundee
1867	Trans.	‖Lunge, Georg, Prof., Ph.D. (Breslau), Rämisstrasse Zürich, Switzerland
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles Mann, D.Sc. (Lond.), F.I.C., University College, and Lozoth, Caversham Heights, Reading
1899		Luxton, Thomas, B.A., B.Sc. (Lond.), 28, Albany-street, Hull
1873		Lyon, Isidore Bernadotte, Brigade Surgeon, Lieut.-Col., C.I.E., F.I.C., East India U.S. Club, 16, St. James's-square, S.W., and 164, Sutherland-avenue, W.
1874		Lyon, John George, F.I.C., The Aire Tar Works, Knottingley, Yorks.
1905		Lyon, Rudolf, 400, Huddersfield-road, Halifax
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72, Brainard-street, Detroit, Mich., U.S.A.
1888		Maben, Thomas, Kenmure, 63, Stradella-road, Herne Hill, S.E.
1896		Macadam, Herbert Edwin, Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson John Charles George, F.I.C., Analytical Laboratory, 55, York-place, Edinburgh
1899		McAlley, James, c/o Johan Bryde, Esq., Sandefjord, Norway
1900		Macara, Thomas, F.I.C., c/o Messrs. Lipton, Ltd., Rouel-road, Bermondsey, S.E.
1890		‖MacArthur, John Stewart, 74, York-street, Glasgow
1887		‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1888		McBretney, Edmund George, F.I.C., 23, Ferrybridge-road, Castleford, Yorks.
1900		McCall, William, 8, Beaton-road, Maxwell-park, Glasgow
1902		MacCallum, Douglas Archibald, Central-chambers, 93, Hope-street, Glasgow
1905		McCleary, William, 61, Station-road, Pendlebury, near Manchester
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1906		McCombie, Hamilton, M.A. (Aberd.), B.Sc. (Lond.), Ph.D. (Strassburg), A.R.C.S., A.I.C., The University, Birmingham

Date of Election.		
1890	Trans.	McConnell, Arthur Hotham, 33, Digby-mansions, Bridge-road, Hammersmith, W.
1904		McCourt, Cyril Douglas, A.C.G.I., 7, Malwood-road, Balham Hill, S.W.
1875		‖McCowan, William, F.I.C., Essex Wharf, Narrow-street, Limehouse, E.
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D. (Heidelberg), 7, Kirklee-gardens, Kelvinside, Glasgow
1899		McCreath, William Dunlop, Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater
1890		‖McCubbin, William Alexander, F.I.C., 35, The Temple, Dale-street, Liverpool
1897		MacCulloch, Charles, Auckland Club, Auckland, New Zealand
1894		McCutcheon, James, 21, Braidburn-crescent, Edinburgh
1903		Macdonald, David Baird, 127, Evington-road, Leicester
1901		Macdonald, F. G., Cyanide Manager, Durban Roodeport Gold Mining Co., Ltd., P.O. Box 111, Roodeport, Transvaal, South Africa
1894	Trans.	MacDonald, George William, M.Sc. (Melbourne), Beechfield, The Park, Birkenhead
1901		Macdonald, Peter, c/o The Mazapil Copper Co., Ltd., Concepcion del Oro, Zacatecas, Mexico
1906		Macdonald, Thomas, Emmotland House, North Frodingham, Driffield, Yorks.
1891		MacDonald, William G., c/o Dr. C. C. Stuhlmann, Tung Wen Kwan, Peking, China
1904		McDougall, Arthur Thomas, B.A. (Lond.), 8, Cliff-terrace, St. John's, S.E.
1906		McDowall, John, Girdstingwood, Kirkcudbright, N.B.
1874		McDougall, John, Clifton House, Greenwich Park, S.E.
1906		Mace, William, Hope, Kingston, Jamaica
1886		MacEwan, Peter, 64, Southwood-lane, Highgate, N.
1898		McEwen, Antholl Francis, 40, Handen-road, Lee, S.E.
1895		MacFarlane, Alexander, Loch Sloy, 5, North-road, Glossop
1891		Macfie, Robert Andrew Scott, M.A. (Cantab.), B.Sc. (Edin.), 34, Moorfields, Liverpool
1895		McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.	McGowan, George, Ph.D. (Leipzig), F.I.C., 21, Montpelier-road, Ealing, W.
1893		McGregory, Joseph Frank, Prof., Colgate University, Hamilton, New York, U.S.A.
1890		Macintyre, Alfred Edgar, Ph.D., The Chemical Laboratory, Dominion Arsenal, Quebec, Canada

Date of Election.			
1877			‖Mackay, Angus, 121, King-street, Great Yarmouth
1890			Mackean, William, c/o Welsbach Incandescent Gas Light Co., Ltd., Broomhill-road, Wandsworth, S.W.
1905			MacKechnie, Robert Drysdale, Productos Quinicos de Huelva, Sociedad Anonyma, Huelva, Spain
1901	Trans.		McKenzie, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Berlin), Birkbeck University College, Bream's Buildings, Chancery-lane, E.C.
1897	Trans.		Mackenzie, John Edwin, D.Sc. (Edin.), Ph.D. (Strassburg), The Technical Institute, Bombay, India.
1902			Mackenzie, John Ross, The Worcester Brewery, Worcester
1899			Mackenzie, Thomas, 4, Church-street, Inverness
1900			Mackenzie, Thomas Ebenezer, The Capillitas Copper Co., Ltd., Pilciao, Provincia de Catamarca, Argentine Republic, S. America
1892			Mackenzie, William Cossar, D.Sc. (Edin.), Tewfikieh College of Agriculture, Gheezeh, Cairo
1893			McKerrow, Charles Alexander, 8, Exchange-street, Manchester
1892			McKerrow, William James, D.Sc. (Tübingen), F.I.C., c/o Messrs. Field and Co., Upper Marsh, Lambeth, S.W.
1897			Maclaurin, James Scott, D.Sc. (N.Z.), Wellington, New Zealand
1868	Trans.	C. 1871-4, 80-4, 87-90, 95-9. V.P. 1887-90, 1901-04	‖McLeod, Herbert, Prof., F.R.S., 9, Coverdale, Montague-road, Richmond, Surrey
1899			McLeod, James, F.I.C., West Hill, Cardross-road, Dumbarton
1903			MacMahon, Frederick William, 31, Marler-road, Forest-hill, S.E.
1879			‖Macmillan, James Laker, 98, Phillip-street, Sydney, N.S.W.
1897			Macmullen, Alan, B.A. (Oxon.), The Manor House, Raheny, R.S.O., Co. Dublin
1881			MacMunn, Charles Alexander, M.A. and M.D. (Dub.), L.R.C.S. (Ireland), Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, Wallaroo Smelting Works, Wallaroo, South Australia.
1880			Macnab, William, F.I.C., 10, Cromwell-crescent, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D. (Würzburg), B.Sc. (Lond.), 67, Braid-avenue, Edinburgh
1900			McNair, Hugh, Gas Manager, Shotts, S.O., Lanarkshire
1905			Maguire, Peter, Hamer House, Rochdale, Lancs.
1899			Main, Hugh, B.Sc. (Lond.), Almondale, Buckingham-road, South Woodford, N.E.
1900			Mair, William, 7, Comiston-road, Edinburgh
1902	Trans.		Maitland, William, B.Sc. (Aberd.), Chemisch-technisches Institut der Technischen Hochschule, Karlsruhe i. B., Germany

Date of Election.			
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1894			Makin, Charles James Shaw, F.I.C., Thorn Bank, Leamington
1885	Trans.		‖Mallet, Frederic Richard, F.I.C., 20, King's-avenue, Ealing, W.
1857	Trans.	{ V.P. 1888-91 }	Mallet, John William, Prof., Ph.D. (Göttingen), M.D. (Louisiana), LL.D. (Princetown, Pennsylvania, and Johns Hopkins), F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, Willie Lee, Gawthorp-green, Kirkheaton, near Huddersfield
1904			Mander, Alfred, Berkswell, Malvern
1903			Mander, Percy George, B.Sc. (Lond.), The School House, Ashby-de-la-Zouch
1903			Mann, Ernest William, Lyndale, Northfield-road, King's Norton, Birmingham
1903			Mann, John Christopher, 9, Lambert-street, Hull
1902			Mann, William, B.Sc. (Lond.), 59, Blackheath-road, Greenwich, S.E.
1896			Manners, Hugh, M.A., B.Sc. (Glas.), Academy House, Airdrie, N.B.
1897			Mansford, Charles John Jodrell, B.A. (Lond.), The Grammar School, Dartford, Kent
1895			‖Marchant, Robert Charles, 18, Elliston-road, Redland, Bristol
1896			Marks, Edward Seaborn, c/o David Marks, Esq., 23, Palace Gate, S.W.
1905			Marle, Ernest Robert, B.Sc. (Lond.), A.R.C.S., 135, Le Marchant-road, St. John's, Newfoundland
1895			Marsden, Prosper Henry, The Royal Infirmary, Liverpool
1902			Marsh, John, 29, High-street, Maidstone
1883	Trans.	C. 1902-	‖Marsh, James Ernest, M.A. (Oxon.), F.R.S., University Museum, Oxford
1895	Trans.		Marshall, Arthur, F.I.C., The Cottage, Dartford, Kent
1890	Trans.		Marshall, Hugh, D.Sc. (Edin.), F.R.S., 12, Lonsdale-terrace, Edinburgh
1896			Marshall, Percy Sykes, Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, 57, Maplethorp-road, Thornton Heath, S.E.
1887			Marshall, William, F.I.C., Carisbrook, Queen's-road, Cheadle Hulme, Cheshire
1897			Martin, Charles Henry, 40, Bolton-road, Pendleton, Salford
1902			Martin, Francis, 3, York-terrace, Eglinton-road, Plumstead, S.E.
1904			Martin, Francis Grimshaw, 1, Harbury-road, Birmingham
1906			Martin, Frederick James, Passagem de Mariana, Minas, Brazil
1906			Martin, George Frederick Wesley, 14, Castle-park, Lancaster

Date of Election.			
1898	Trans.		‖Martin, George Herbert, M.A. (Oxon.), 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Gerald Ward, Lieut.-Col., 8, Petersham-terrace, Gloucester-road, S.W.
1905			Martin, Harry, 14, Hardman-street, Liverpool
1901			Martin, Nicholas Henry, Ravenswood, Low Fell, Gateshead-on-Tyne
1902			Martindale, William Harrison, 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C., and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Northwood, Rydal-road, Streatham, S.W.
1898			Mascarenhas, John Charles, Lisbon House, 54, Percy-road, Upton Park, E.
1851	Trans.	C. 1858-9, 75-7. V.P. 78-81	Maskelyne, Nevil Story, M.A., Hon. D.Sc. (Oxon.), F.R.S., F.I.C., Salthrop, Wroughton, Wilts.
1905			Mason, Arthur Walter, B.Sc. (Lond.), 6, Northumberland-place, North Shields
1890			Mason, Francis Herbert, c/o The Johnson Graham Mining Co., Plumas Eureka Mines, Johnsville, Cal., U.S.A.
1889			Mason, James Braik, The West End Laboratory, Dundee
1882	Trans.		Masson, David Orme, Prof., M.A., D.Sc. (Edin.), F.R.S., The University of Melbourne, Victoria, Australia
1897			Masters, Edward, Rock Mount, 186, Hinckley-road, Leicester
1873			‖Masters, William, St. Erme, Moorend Park-road, Cheltenham
1904			Mathews, Harold Joseph Clarke, Massey's Burnley Brewery, Ltd., Burnley, Lancs.
1896			Mathieson, Laurence Weir, Conway, Rosebery-road, Gillingham, S.O., Kent
1902			Mathieson, Robert, J.P., Rill Bank, Innerleithen, Peeblesshire
1876	Trans.		‖Matthews, Charles George, F.I.C., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1880	Trans.	C. 1906-	‖Matthews, Francis Edward, Ph.D. (Göttingen), F.I.C., 6, Hillcroft-crescent, Ealing, W.
1884			‖Matthey, Edward, Col., C.B., A.R.S.M., 31a, Weymouth-street, W.
1870		C. 1877-9	Matthey, George, Assoc.Inst.C.E., F.R.S., 78, Hatton-garden, E.C.
1905			Maughan, Reginald Bruce, P.O. Box, 46, Bundaberg, Queensland
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. (Cantab.), F.R.C.S. (Edin.), B.Sc. (Lond.), 29, Woolwich Common, S.E.
1896			Mayfield, Arthur Stanley, Thilmere, Newland, Hull
1892			Meacham, Charles Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, South Africa

Date of Election.			
1898			Meads, Charles James, Bel Air, Dartmouth, Devon
1904			Mears, Francis D'Oyley, jun., 4, Nyanza-terrace, Swansea
1901	Trans.		Mees, Charles Edward Kenneth, B.Sc. (Lond.), 76, Canterbury-road, Croydon
1896			Meggitt, Loxley, F.I.C., c/o C.W.S., Ltd., Wheatsheaf Works, Alexandria, Sydney, N.S.W.
1871	Trans.	C. 1883-7, 90-91 F.S. 1891-1902 V.P. 1902–05 P. 1905–	‖Meldola, Raphael, Prof., F.R.S., F.I.C., Finsbury Technica College, Leonard-street, E.C., and 6, Brunswick-square, W.C.
1905	Trans.		Meldrum, Andrew Norman, D.Sc. (Aberd.), 16, Mooroaks-road, Sheffield
1895			Meldrum, Robert, Glynwood, 37, Foyle-road, Blackheath, S.E.
1894			Melland, Godfrey, M.Sc. (Vict.), A.R.S.M., F.I.C., Chemica Department, The Polytechnic, Woolwich, S.E.
1902	Trans.		Mellor, Joseph William, D.Sc. (N.Z.), West View, near Longpor Station, Wolstanton, Staffs.
1875			‖Melmore, Pattinson Banks, Chemical Laboratory, Maryport
1902			Mence, George Augustus Henry, B.Sc., The Grammar School Lincoln
1900	Proc.		Menzies, Alan Wilfrid Cranbrook, Prof., M.A. and B.Sc. (Edin.) St. Mungo's College, Castle-street, Glasgow
1901			Menzies, James, 39, Winterbrook-road, Herne Hill, S.E.
1889			Mercer, Thomas, F.I.C., The Lion Brewery, Eastbourne
1901			Meredith, William, 63, Albion-place, Ulverston, Lancs.
1896			Merrett, William Henry, A.R.S.M., F.I.C., Hatherley, Grosvenor road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland-park, Sheffield
1897			Merson, George Fowlie, 7, King-street, Kilmarnock, N.B.
1876	Trans.	C. 1884-8, 1897-1901 V.P. 1906-	‖Messel, Rudolph, Ph.D. (Tübingen), 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans, Ph.D., 1, Salmgasse, Prague, Bohemia
1905			Micklewright, Harry George Fletcher, B.A. (Oxon.), 116, St James'-road, Croydon
1904			Middleditch, Bernard, B.A. (Cantab.), Woodcroft, Harrow-on the-Hill
1888	Trans.	V.P. 1901-04	‖Miers, Henry Alexander, Prof., M.A., D.Sc. (Oxon.), F.R.S. Magdalen College, Oxford
1904			Millar, Ernest Westby, Windsor, Monkstown, Co. Dublin.
1843			‖Millar, James.
1892	Trans.		Millar, James Hill, F.I.C., The Laboratory, St. James' Gat Brewery, Dublin

Date of Election.			
1891			‖Millard, Edgar James, 35–42, Charlotte-street, Great Eastern-street, E.C.
1905			Millen, John Dunlop, c/o The Mount Bischoff Co., Launceston, Tasmania
1880	Trans.		‖Miller, Alexander Kenneth, Ph.D. (Würzburg), F.I.C., Kilvert's-buildings, Withy Grove, Manchester
1897			Miller, Edmund Howd, M.A., Ph.D. (Columbia), Columbia University, New York City, U.S.A.
1902			Miller, Edward Holl, 81, Chardmore-road, Stoke Newington, N.
1889			Miller, Harry East, Ph.D. (Strassburg), 1015, Chestnut-street, Oakland, California, U.S.A.
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc. (Illinois), Ph.D. (Berlin), 44 & 45. Lewis Block, Buffalo, New York, U.S.A.
1885	Trans.		‖Miller, Norman Harry John, Ph.D. (Würzburg), F.I.C., Harpenden, Herts.
1898			Miller, William Lash, B.A. (Toronto), Ph.D. (Munich), 50, St. Alban-street, Toronto, Canada
1896			Miller, William Murray, Caledonia Estate, Province Wellesley, Penang, Straits Settlements
1902	Proc.		Millington, John Price, B.A. (Cantab.), B.Sc. (Wales), Royal Societies' Club, St. James's-street, S.W.
1893	Trans.		‖Mills, Charles, F.I.C., P.O. Box 112, Kroonstad, South Africa
1862	Trans.	C. 1868-72, 75-6, 80-4, 1903-06	‖Mills, Edmund James, Prof., D.Sc. (Lond.), LL.D. (Glas.), F.R.S., F.I.C., 64, Twyford-avenue, West Acton, W.
1906			Mills, Herbert Arthur, 3, Croxted-road, West Dulwich, S.E.
1898	Trans.		Mills, William Hobson, M.A. (Cantab.), Sc.D. (Tübingen), The Northern Polytechnic Institute, Holloway, N.
1905	Trans.		Mills, William Sloan, M.A., D.Sc. and B.E. (R.U.I.), Chemical Dept., The Polytechnic, Woolwich, S.E.
1885			‖Milne, Alexander, Lieut.-Col. I.M.S., M.A., M.B. and M.Ch. (Aberd.), H.M.'s Mint, Bombay, India.
1887			Mingaye, John Charles Henderson, F.I.C., Department of Mines, Assay Branch, Sydney, N.S.W.
1898			‖Mitchell, Albert Henry, B.Sc. (Lond.), F.I.C., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1905			‖Modi, Edalji Manekji, Opposite Grant-road-station, Sleater-road, Bombay, India
1899			Mohr, Bernard, Ph.D. (Heidelberg), 69A, Parliament Hill, Hampstead, N.W.
1901	Trans.		Moir, James, M.A., D.Sc. (Aberd.), Chemical Laboratory, Mines Department, Winchester House, Johannesburg, Transvaal, South Africa.

Date of Election.			
1893			Mole, Herbert Bloome, The Croft, Shepton Mallet
1902			Molesworth, Francis Hylton, Jersey-road, Artarmon, Sydney, N.S.W.
1899			Molson, John Cavendish, M.D. (Chicago), L.R.C.P. (Lond.), 1, Pavilion-buildings, Brighton
1899			Mond, Emile Schweich, 22, Hyde-park-square, W.
1872	Trans.	C. 1885-6 V.P. 87-90, 94-8	‖Mond, Ludwig, Hon. D.Sc. (Vict.), Hon. Ph.D. (Heidelberg), F.R.S., F.I.C., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A. (Cantab.), F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1879			‖Mondy, Edmund Felix, A.R.S.M., Dacca, 96, Huron-road, Balham, S.W.
1903	Trans.		Monier-Williams, Gordon Wickham, M.A. (Oxon.), Ph.D. (Freiburg), A.I.C., The Lammas, Esher, Surrey
1904			Montgomery, Jack Percival, Ph.D. (Virginia), A.M. (Clarksville), Agricultural College, Starkville, Miss., U.S.A.
1887	Trans.	C. 1899-1900, 1905-	‖Moody, Gerald Tattersall, D.Sc. (Lond.), F.I.C., Lorne House, North Dulwich, S.E.
1902			Moody, James Butler, Bridge Cottage, Wakefield
1897			Moon, Philip George Gregory, The Laboratory, British Gas Light Co., Ltd., Norwich
1892			‖Moor, Cresacre George, M.A. (Cantab.), F.I.C., 4, Dane's Inn, Strand, W.C.
1903			Moore, Alfred Ernest, B.A., B.Sc. (Lond.), Escuela Normal Regional, Corrientes, Argentine Republic
1903			Moore, Arthur, 109, Elgin-road, Seven Kings, Essex
1905	Trans.		Moore, Charles Watson, B.Sc. (Vict.), Chemiegebäude des Polytechnikums, Zürich, Switzerland
1891			Moore, Frederick Herbert, 39, Lime-street, E.C.
1902			Moore, Thomas Henry, c/o Messrs. Burroughs, Wellcome & Co., Ltd., Box 1013, Cape Town, South Africa
1904	Trans.		Moore, Tom Sidney, B.A. (Oxon.), B.Sc. (Lond.), Magdalen College, Oxford
1895			Morgan, David James, M.A., M.D. and B.C. (Cantab.), D.P.H. (Lond.), Holkham, St. James'-road, Sutton, Surrey
1897			Morgan, Frederick Filmer de, 4, Orchard-house, County Grove, Camberwell, S.E.
1898	Trans.		‖Morgan, Gilbert Thomas, D.Sc. (Lond.), A.R.C.S., F.I.C., Royal College of Science, South Kensington, S.W., and 15, Fawcett-street, Redcliffe-gardens, S.W.
1888			‖Morgan, John James, F.I.C., The Laboratory, Messrs. Cammell, Laird and Co., Ltd., Workington, Cumberland
1900			Morgan, John Livingston Rutgers, Prof., A.M., Ph.D. (Leipzig), B.Sc., Columbia University, New York, U.S.A.

Date of Election.			
1880	Trans.		Moritz, Edward Ralph, Ph.D. (Göttingen), F.I.C., 45, Great Tower-street, E.C.
1879	Trans.	C. 87-90 96-1900	‖Morley, Henry Forster, M.A., D.Sc. (Lond.), F.I.C., 5, Lyndhurst-road, South Hampstead, N.W.
1895	Trans.		‖Morrell, Robert Selby, M.A. (Cantab.), Ph.D. (Würzburg), c/o Messrs. Mander Bros., Wolverhampton, and South Bank, Compton, Wolverhampton
1892			Morris, Albert, B.A., B.Sc. (Lond.), Fern Bank, Ashton-under-Lyne
1906			Morris, Eric Haydn, c/o Messrs. G. Mowling and Son, Chemical Works, Footscray, Melbourne, Australia
1900			Morris, Edgar Ford, M.A. (Oxon.), Grey House, Barrington-road, Altrincham, Cheshire
1905			Morris, Edwin, A.R.C.S., A.R.S.M., 12, Dragon-view, Harrogate
1891			Morris, Joseph, Ph.D., Fern Bank, 8, Boardman-street, Eccles, Manchester
1851			Morson, Thomas, c/o Messrs. T. Morson and Son, Chemical Works, Ponders End, N.
1905			Mortimer, Alfred, B.A. (Oxon.), Aldenham School, Elstree, Herts.
1872			Morton, Edward Handfield, 88, Wigmore-street, W.
1893			Morton, Frederick, Chemical Works, Milnsbridge, Huddersfield
1890	Trans.		Mosenthal, Henry de, F.I.C., 220, Winchester-house, Old Broad-street, E.C.
1896			Moss, Francis Ambrose, Kalgurli Gold Mines, Ltd, Kalgoorlie, Western Australia
1871			‖Moss, Richard Jackson, F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, William Edward, 2, Windermere-terrace, Princes-park, Liverpool
1905			Motion, John, c/o Valvoline Oil Co., Edgewater, New Jersey, U.S.A.
1886			Moul, Frank, F.I.C., Aldersgate Chemical Works, Southall
1884			‖Moyle, Robert Edward, M.A. (Oxon.), Heightley, Chudleigh, South Devon
1902			Müller, Christian, 9, Baronsfield-road, East Twickenham, Middlesex
1859	Trans.	C. 1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D. (Göttingen), LL.D. (St. Andrews), F.R.S., 13, Park-square East, Regent's Park, N.W.
1896			Muir, James Stanley, B.Sc. (Glas.), 8, Westminster-gardens, Hillhead, Glasgow
1871	Trans.	C. 1890-4	Muir, Matthew Moncrieff Pattison, M.A. (Cantab.), Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc. (Lond.), F.R.S., The Lodge, Shortlands, Kent

Date of Election.		
1902		Mukerjee, Beni Madhav, B.A. (Allahabad), Thomason College, Roorkee, India
1906		Mukerjee, Ram Chandra, Prof., B.A., Maharaja's College, Jaipur, Rajputana, India
1906		Mummery, William Rest, A.I.C., c/o De Beers Explosive Works, Somerset West, Cape Colony, S. Africa
1893	Proc.	Munby, Alan Edward, M.A. (Cantab.), Royal Societies' Club, St. James'-street, S.W.
1902		Mundey, Alfred Holley, 14, Wrottesley-road, Plumstead, Kent
1876	Trans.	Munro, John May Herbert, D.Sc. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 5, Duke-street, Bath
1888		Munroe, Charles Edward, Prof., George Washington University, Washington, D.C., U.S.A.
1900		Munton, Frederick Thomas, The Oak House, Winsford, Cheshire
1901		Murphy, Albert John, 11, Lyddon-terrace, Leeds
1904		Murray, Benjamin Lindley, A.M. (Columbia), B.S. (Michigan), 19, University-place, New York, U.S.A.
1893		Murray, John Alan, B.Sc. (Edin.), 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894		Murray, John Moore, M.Sc. (Vict.), 11, Winmarleigh-street, Warrington
1906		Murray, Thomas Jenkins, Ph.D. (Leipzig), The University, Birmingham
1890	Trans.	‖Murray, Thomas Smith, D.Sc. (Edin.), 1, Nelson-street, Dundee
1869		‖Muspratt, Edmund Knowles, F.I.C., Seaforth Hall, near Liverpool
1873		‖Muspratt, Sidney Knowles, 9, Church-street, Flint, North Wales
1896		Muter, Alexander Henry Mitchell, F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1870	Trans.	‖Muter, John, Ph.D. (Rostock), F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.	Myers, William Shields, M.Sc. (N.J.), Director of Nitrate Propaganda for United States and Colonies, 12–16, John-street, New York, U.S.A.
1887		Nagel, David Henry, M.A. (Oxon.), Trinity College, Oxford
1903		Nairne, Urban Orlando Scotchburn, 7, Hawthorne-terrace, Ripple-road, Barking, Essex
1899	Proc.	Nance, John Trengove, M.A. (Oxon.), Elmshurst, Bromsgrove, Worcs.
1874		‖Napier, Arthur S., Prof., B.Sc., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinandstrasse, Berlin
1893		Napier, John Watson, Corporation Gas Works, Alloa, N.B.
1900	Proc.	Napper, Sidney Scrivener, A.C.G.I., A.I.C., c/o Messrs. S. Cortauld and Co., Ltd., Foleshill-road, Coventry

Date of Election.		
1898		Nash, Leonard Myddelton, F.I.C., 3, Princess-road, Finsbury, Park, N.
1900		Naylor, Ernest Brooks, M.Sc. (Vict.), 73, Castle-street, Bolton
1891		Naylor, William, 3, Garstang-road, Fulwood-park, Preston
1878	Trans.	Naylor, William Arthur Harrison, F.I.C., 38, Southwark-street, S.E.
1899	Trans.	Neale, Harry Ainley, Vernon, British Columbia
1898		Neilson, Alexander MacGillivray, c/o Messrs. Arthur May and Co., Durban, Natal, South Africa
1901		Neumann, Edgar David Maurice, M.A. (Oxon.), Ph.D. (Göttingen), A.I.C., 7 & 8, Idol-lane, E.C.
1878	Trans.	‖Nevile, Ralph Henry Christopher, Wellingore Hall, Lincoln
1871	Trans.	‖Nevill, Edmund Neville, F.I.C., Government Laboratory, Durban, Natal
1890	Trans.	Neville, Francis Henry, M.A. (Cantab.), F.R.S., Sidney College, Cambridge
1905	Trans.	Neville, Henry Allen Dugdale, B.Sc. (Lond.), A.I.C., 81, Revidge-road, Blackburn
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, Balliol College Laboratory, Oxford
1901		Newbould, Herbert Simpson, 15, York-road, Heaton Moor, near Stockport
1864		‖Newlands, Benjamin Edward Reina, F.I.C., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William Peter Reina, 10, Cricklade-avenue, Streatham Hill, S.W.
1889		Newsholme, George Thomas Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, George S., F.I.C., Royal College of Science, South Kensington, S.W.
1895		Newton, Charles Butterworth, Whitehall-chambers, Carlisle
1883		Newton, William, Ph.D. (Zürich), F.I.C., 39, Mincing-lane, E.C.
1899	Proc.	Nicholls, William Walter Scott, B.Sc. (Lond.), 230, Brockley-road, Brockley, S.E.
1870	Trans.	‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., M.R.C.S. (Eng.), L.S.A. (Lond.), D.P.H. (Cantab.), F.I.C., 1, Huskisson-street, Liverpool
1889		Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892		Nickolls, John Bate, The Royal Societies Club, St. James's-street, S.W.
1883	Trans.	Nicol, William Walker James, M.A., D.Sc. (Edin.), F.I.C., 15, Blacket-place, Edinburgh
1900		Nightingale, Thomas Marginson, B.Sc. (Vict.), 375, Bridgman-street, Bolton
1898		Nightscales, Thomas Arthur, 2, St. James'-parade, Hull

Date of Election.			
1894			Nixon, Alfred, 7, Oak-road, Sale, Manchester
1869			Noble, Sir Andrew, Bart., K.C.B., D.C.L. (Dun.), F.R.S., Jesmond Dene House, Newcastle on-Tyne
1903	Trans.		Norman, George Marshall, B.Sc. (Lond.), A.R.C.S., A.I.C., 2, Bartholomews, Brighton
1889			Norman, John Thomas, 23, Leadenhall-street, E.C.
1861			Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892			Norris, Charles James, 31, Airedale-avenue, Chiswick, W.
1897	Trans.		North, Barker, Glenholme, Glenholme-road, Manningham, Bradford
1899	Trans.		Northall-Laurie, Dudley, F.I.C., King's College, Strand, W.C.
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, Thomas Herbert, Prof., Ph.D. (Heidelberg), D.Sc. (Hamilton), c/o The John Crerar Library, Chicago, Ill., U.S.A.
1901			Nunn, Arthur William, 57, Crouch-street, Colchester
1904			Oakden, William Edward, 2, Gledhow-terrace, South Kensington, S.W.
1893	Trans.		Oates, William Henry, Broomhall-park, Sheffield
1903			O'Brien, Frederick, 87, Dongola-road, Horfield, Bristol
1902			O'Connor, Sinnott Valentine, 14, Selskar-street, Wexford
1890			Oddy, Robert Walter, F.I.C., Waterhouse, Toad-lane, Rochdale
1873			‖Odling, Walter, F.I.C., c/o Messrs. Bass and Co., Burton-on-Tren
1848	Trans.	S. 1856-69 V.P. 1869-73, P. 1873-5	Odling, William, Prof., M.A. (Oxon.), M.B. and F.R.C.P. (Lond.), Hon. Ph.D. (Leyden), F.R.S., F.I.C., 15, Norham-gardens, Oxford
1905			‖O'Farrelly, Alfons, M.A. (R.U.I.), 3, Holles-street, Dublin
1902			Ogilvie, Allan, Frodingham House, Frodingham, near Doncaster
1901			Oldershaw, William, Strelley, Nottingham
1904			Oldfield, Laurel Cecil Francis, Lincoln College, Oxford
1906			Oliver, Edgar Gale, M.A. (Cantab.), Chigwell School, Essex
1889			O'Mahony, Daniel John, Municipal-buildings, Cork
1901			Oram, Frank, Market-place, Romsey
1890	Trans.		Ormandy, William Reginald, c/o Crossfield's Soap Works Warrington
1869			‖Orme, Temple A., University College, W.C., and 213, Uxbridge road, W.
1906	Trans.		Ormerod, Ernest, M.Sc. (Vict.), Ph.D. (Basel), The Oaklands Rochdale, Lancs.
1872			‖Ormerod, Joseph Arderne, M.D. (Oxon.), M.R.C.S. (Eng.) F.R.C.P. (Lond.), The Medical Committee Room, St Bartholomew's Hospital, E.C.

Date of Election.			
1887			‖Ormiston, Archibald R., Bracholm, Helensburgh; and 213, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, N.S.W.
1881			Orr, John Bryson, Crossacres, Much Woolton, Liverpool
1897	Trans.		Orton, Kennedy Joseph Previté, Prof., M.A. (Cantab.), Ph.D. (Heidelberg), F.I.C., Llwyn Eithin, and University College of North Wales, Bangor
1881	Trans.		O'Shea, Lucius Trant, B.Sc., The Cottage, East Cosham, Hants.
1887			Ostersetzer, Julius, F.I.C., c/o Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1876	Trans.	C.1882-6 V.P.93-6	†O'Sullivan, Cornelius, F.R.S., F.I.C., 148, High-street, Burton-on-Trent
1883	Trans.		O'Sullivan, James, F.I.C., High Bank, Burton-on-Trent
1899			O'Sullivan, John, 1461, Georgia-street, Vancouver City, B.C.
1887			‖O'Sullivan, Patrick Thomas, M.D. and B.Ch. (R.U.I.), 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto Christoph Joseph Gerhard Ludwig, Chantry House, Great Grimsby
1887			‖Overend, Frederick Lawrence, B.A. (Oxon.), 98, Rowley-street, Walsall
1871	Trans.	C. 1889-94	‖Page, Frederick James Montague, B.Sc. (Lond.), A.R.S.M., F.I.C., 54, Sutherland-street, Pimlico, S.W.
1904			Page, William Davidge, 17, Surrey-street, Strand, W.C.
1898	Trans.		Pakes, Walter Charles Cross, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Cantab.), F.I.C., The Government Laboratories, P.O. Box 1080, Johannesburg, South Africa
1884			‖Pallister, John William, B.Sc. (Lond.), 107, Waverley-road, Bradford
1882			Palmer, Alfred Neobard, Ingle Nook, Bersham-road, Wrexham
1906			Palmer, Arthur Charles, B.Sc. (Lond.), 17, Wansbeck-gardens, West Hartlepool
1888			Palmer, Henry John, Banff, Alberta, Canada
1899			Palmer, Thomas Henry, Amalfi, Longueville, Sydney, N.S.W.
1879			Palmer, Sir Walter, Bart., B.Sc. (Lond.), The College, Reading, and 50, Grosvenor-square, W.
1902			Panisset, Sydney Glyde Stephen, 3, Weston-road, Strood, Kent
1899	Trans.		Panting, Laurence Christopher, M.A., M.D. and B.Ch. (Oxon.), 45, Lemon-street, Truro
1900			Pardy, Alexander, Central Experiment Farm, Cedara, Natal, South Africa

† Longstaff Medallist, 1884.

Date of Election.			
1906			Parfitt, Samuel, 33, Partridge-road, Cardiff
1898			Parker, Alfred James, 43, Harcourt-street, Blackburn, Lancs.
1897			Parker, Charles Henry, Merrills House, March End, Wednesfield
1882			Parker, Joseph Richard, Avondale, 129, Kyverdale-road, Stoke Newington, N.
1894	Trans.		Parker, Matthew Archibald, Prof., B.Sc. (Glas.), University of Manitoba, Winnipeg, Canada
1882			‖Parker, Robert Henry, 35, Clifton-road, Maida Vale, W.
1901			Parkes, Albert Edward, F.I.C., Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890			Parkes, Thomas, M.A. (Cantab.), 2, Gawber-road, Barnsley
1906			‖Parkin, John, M.A. (Cantab.), Blaithwaite, Carlisle
1865	Trans.		‖Parkinson, James, Queen's-chambers, Pirie-street, Adelaide, South Australia
1893			Parrish, Samuel, B.Sc. (Lond.), 80, Grange-avenue, Chapeltown-road, Leeds
1892			Parry, Ernest John, B.Sc. (Lond.), F.I.C., 208, High-street, Borough, S.E.
1903			Parry, George Harry, The Level, Brierley Hill, Staffs.
1903			Parry, William, B.Sc. (Lond.), 19, Hyde-road, Waterloo, Liverpool
1870			Patchett, Isaac, F.I.C., 11, Osborne-terrace, Field-hill, Batley
1894	Trans.		Paterson, David, F.R.S.E., Lea Bank, Rosslyn, Midlothian, N.B.
1885	Trans.		Patterson, George, F.I.C., The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, Joseph William, 14, Mitchell-street, West Hartlepool, Durham
1870	Trans.		Patterson, Thomas Law, F.I.C., Maybank, Finnart-street, Greenock
1904	Trans.		Patterson, Thomas Stewart, Ph.D. (Heidelberg), Chemical Department, The University, Glasgow
1863	Trans.	{ V.P. 1891-4 }	Pattinson, John, F.I.C., 10, Dean-street, Newcastle-on-Tyne
1868	Trans.		‖Paul, Benjamin Horatio, Ph.D. (Giessen), Analytical Laboratory, 13, Fenchurch-street, E.C., and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D. (Tübingen), F.I.C., Market Hall chambers, King-street, Huddersfield
1901			Pay, Walter Herbert, Government Laboratory, Durban, Natal
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Mosley-street, Newcastle-on-Tyne
1893			Payne, George Frederick, M.D. (Atlanta), 43½, Whitehall-street, Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley John, School of Technology, Whitworth-street, Manchester

Date of Election.			
1901			Peacock, Arthur, B.Sc. (Vict.), The Brebner Schools, Bloemfontein, South Africa
1900			Pearce, Ernest Vivian, The Hollies, Hayle, Cornwall
1874			Pearce, William, M.P., Chemical Works, Bow Common, E.
1906			Pearse, Leonard Edward Beard, 79, Woodville-road, Ealing, W.
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1902			Peck, John Wicliffe, 28, West Ella-road, Harlesden, N.W.
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.		‖Pedler, Sir Alexander, Prof., C.I.E., F.R.S., F.I.C., Director of Public Instruction, Writer's-buildings, Calcutta, India
1904			Pell, Alfred, 44, Cumballa-hill, Bombay, India
1906			Pendlebury, Harold Lawson, 4, Wentworth-street, Bolton.
1886	Proc.		Pendlebury, William Henry, M.A. (Oxon.), Woodford House, Mountfield, Shrewsbury
1905			Penn, Francis Richard, A.R.C.S., Highthorne-terrace, Shadwell-lane, Moortown, Leeds
1870			Penney, Mulgrave Daniel, 11, High-street, Hull
1895			Pennington, William Henry, Field House, Rochdale
1905			Pennycuick, Thomas, B.Sc. (Lond.), 20, Avon-street, Belmont-road, Liverpool
1906			Pennymore, Percy George, Eskbank Iron and Steel Works, Lithgow, N.S.W.
1886			Pentecost, Stephen James, Nottingham-road, New Basford, Notts.
1884	Trans.	C. 1906-	Perkin, Arthur George, F.R.S., F.I.C., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick Mollwo, Ph.D. (Würzburg), Borough Polytechnic, Borough-road, S.E.
1856	Trans.	C. 1861-2 1868-9 S. 1869-83 P. 1883-5	†‖Perkin, Sir William Henry, Hon. LL.D. (St. Andrews), Hon. Ph.D. (Würzburg and Heidelberg), Hon. D.Sc. (Vict.), F.R.S., F.I.C., The Chestnuts, Sudbury, Harrow
1884	Trans.	C. 1891-5 V.P. 1906-	*Perkin, William Henry, jun., Prof., Ph.D. (Würzburg), F.R.S., F.I.C., Fairview, Wilbraham-road, Fallowfield, Manchester
1905			Perkins, Hugh Donald, Richmond House, Strand, Ryde, I.o.W.
1906			Perkins, William Hughes, B.Sc. (Manc.), The University, Leeds
1890	Trans.		‖Perman, Edgar Philip, D.Sc. (Lond.), University College, Cardiff
1905			Perrott, Bert, Ael-y-Bryn, Penywern-road, Neath, Glam.
1888			Perry, George Edward, 103, Stirling-road, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Mosley-street, Manchester
1902			Phelps, John, M.A. (Oxon.), The Royal Mint, E., and 9, Hawes-road, Bromley, Kent

† Longstaff Medallist, 1888.
* Longstaff Medallist, 1900.

Date of Election.			
1881			Philip, Arnold, B.Sc. (Lond.), A.R.S.M., F.I.C., Chemical Laboratory, H.M. Dockyard, Portsmouth
1897	Trans.		Philip, James Charles, M.A. and D.Sc. (Aberd.), Ph.D. (Göttingen), Royal College of Science, South Kensington, S.W.
1887			Phillips, Arthur Gaved, A.R.S.M., F.I.C., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1904			Phillips, George Frederick Tyler, B.Sc. (Lond.), University College, Southampton
1897			Phillips, Harry Edward William, B.A. (Oxon.), The Laurels, Eynsham, Oxford
1882			Phillips, Henry Harcourt, Lynwood, Turton, Lancs.
1902	Trans.		Phillips, Percy Philip, Ph.D. (Göttingen), Thomason Engineering College, Rurki, North-West Provinces, India
1900			Phillpotts, Geoffrey Surtees, B.A. (Cantab.), 82, James-street, Dublin
1905			Phipson, Percy Barker, c/o Messrs. J. Staples and Co., Ltd., Wellington, New Zealand
1897	Trans.		‖Pickard, Robert Howson, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), F.I.C., Municipal Technical School, Blackburn
1891			Pickering, Michael Samuel, B.Sc. (Lond.), 38, Price-street, Burslem
1878	Trans.	C.1886-7 89-93 1901-04	‖Pickering, Spencer Percival Umfreville, M.A. (Oxon.), F.R.S., F.I.C., Harpenden, Herts.
1906	Trans.		Pickles, Samuel Shrowder, B.Sc. (Vict.), Imperial Institute, S.W.
1890	Trans.		‖Picton, Harold, B.Sc. (Lond.), Clacton College, Clacton-on-Sea
1894			Pike, Ernest Brooke, Grasmere, 515, Romford-road, Forest Gate, E.
1903			Pike, Henry George, College of Agriculture, Downton, Salisbury, Wilts.
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D. (Göttingen), Sandhills, Salcombe, R.S.O., Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, Thomas William, 33, Grove-hill-road, Denmark Hill, S.E.
1904			Pinchbeck, Gerald, 10, Vernon-avenue, Eccles, Manchester
1889			Ping, William, 14, Selsdon-road, Wanstead, N.E.
1889			Pingstone, George Arthur, Public Analyst, P.O. Box 445, Bulawayo, South Africa
1904			Pinkerton, David John, Dalzell Steel and Iron Works, Motherwell, N.B.
1881			Pisani, Orestes Victoriano, Effingham House, Arundel-street, Strand, W.C.
1903	Trans.		Pitt, Arthur Ernest, 66, Abbott-road, Bromley, E.
1903			Pitt, Harold Russell, 8, Church-lane, Charlton, S.E.

Date of Election.			
1882			‖Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, Frederick Williams, St. Nicholas' Buildings West, Newcastle-on-Tyne
1899			Pizey, James Henry, A.R.C.S., A.I.C., Bella Vista 19, Minas de Rio Tinto, Provincia de Huelva, Spain
1893			Platt, Charles, M.D., Ph.D., Hahnemann Medical College, Philadelphia, U.S.A.
1860			‖Player, Jacob Hort, 16, Prince Arthur-road, Hampstead, N.W.
1899	Trans.		‖Plimmer, Robert Henry Aders, D.Sc. (Lond.), 3, Hall-road, N.W.
1903			Plymen, George Horace Gladstone, 44, Harlesden-gardens, Harlesden, N.W.
1899			Polkinghorne, Bennett Corcyra, B.Sc. (Lond.), 17, Humber-road, Blackheath, S.E.
1888			Pollard, Frederick Ernest, F.I.C., 14, Old Hall-street, Hertford
1898	Trans.		Pollard, William, M.A. (Cantab.), D.Sc. (Tübingen), The Museum, Jermyn-street, S.W.
1903			‖Pollard, William Branch, B.A. (Cantab.), Survey Department, Finance Ministry, Giza, Egypt
1902			Pollitt, George Paton, B.Sc. (Vict.), Ph.D. (Basel), Winnington, Northwich, Cheshire
1901			Pollitt, James Charles Tomlin, Church-hill, Solihull, Warwickshire
1896			Pollitt, Robert Barnabas, F.I.C., c/o The De Beers Explosive Works, Cape Town, South Africa
1897			Pollitt, Samuel, B.Sc. (Vict.), Tottenham County School, Grove House, South Tottenham, N.
1894	Trans.		‖Pollok, James Holms, D.Sc. (Glas.), Royal College of Science, Stephen's-green, Dublin
1903			Pond, George Gilbert, Prof., M.A. and Ph.D. (Amherst), State College, Pennsylvania, U.S.A.
1890			Pond, James Alexander, Auckland, New Zealand
1899			Ponthieu, Georges, 25, St. Jean Baptiste, Montreal, Canada
1848			Pontifex, Edmund Alfred, M.Inst.C.E., 6, Cadogan-court-gardens, Cadogan-place, S.W.
1905			Pooler, Frederick John, B.Sc. (Birm.), 26, Green-street, Smethwick, Birmingham
1898	Trans.		Pope, Thomas Henry, B.Sc. (Lond.), A.C.G.I., F.I.C., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	†‖Pope, William Jackson, Prof., F.R.S., F.I.C., Corchester, Bramhall, Cheshire
1903			Porter, Robert James, 11, Arlington-street, Hull
1884	Proc.		‖Porter, Thomas Cunningham, M.A. (Oxon.), Upton-park, Slough
1904			Porter, Thomas Linton Daniel, B.Sc. (Lond.), 161, Downsell-road, Stratford New Town, E.

† Longstaff Medallist, 1903.

Date of Election.			
1895			Potter, Arthur Edward, M.A. (Cantab.), B.Sc. (Lond.), Senior Inspector of Schools, Rangoon, Burma, India
1883			Potter, Charles Edward, c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland Samuel, Eastbury, Uplands-park-avenue, Loughton, Essex
1896			Potts, Henry William, Hawkesbury Agricultural College, Richmond, N.S.W.
1895			Powell, Harry James, 530, Lordship-lane, S.E.
1896	Trans.		Power, Frederick Belding, Ph.D. (Strassburg), 6, King-street, Snow-hill, E.C.
1884			‖Power, Francis Reginald, The Royal Mint, Melbourne, Australia
1902			Powney, William Edmund Francis, 10, Alexandra-villas, Finsbury Park, N.
1904	Trans.		Prentice, Bertram, Ph.D. (Munich), D.Sc. (Edin.), Royal Technical Institute, Salford
1902			Přibram, Richard, Hofrat Prof. Dr., Horlgasse 9, Vienna IX., Austria
1882			‖Price, Arthur Faraday, 2503, Broadway, San Francisco, Cal., U.S.A.
1899			Price, Robert Coleman, Prof., The Miller School, P.O., Albemarle Co., Va., U.S.A.
1901	Trans.		Price, Thomas Slater, D.Sc. (Lond. and Birm.), Ph.D. (Leipzig), F.I.C., Chemical Department, Municipal Technical College, Suffolk-street, Birmingham
1889			‖Priestley, Charles William, B.Sc. (Lond.), A.R.C.S., Richmond Lodge, Torquay
1870			Pritchard, William, Prof., President, Royal Veterinary College, N.W., and 5, Regent's Park-road, Gloucester-gate, N.W.
1871	Trans.		‖Procter, Henry Richardson, Prof., Hon. M.Sc. (Leeds), F.I.C., The University, Leeds, and Rowangarth, Ben Rhydding, viâ Leeds
1889	Trans.		Proctor, Charles, F.I.C., 27, London-road, Forest Hill, S.E.
1896	Proc.		Proude, James, 30, Cromwell-terrace, Halifax
1897			Pullar, Herbert Spindler, Pullar's Dye Works, Perth, N.B.
1882			‖Pullar, Rufus Daniell, Brahan, Perth
1902			Puntan, Herbert Harding Cruikshank, Borough Analyst, London-chambers, Durban, Natal
1875	Trans.	C 1888-92 V.P. 1899-1902	Purdie, Thomas, Prof., Ph.D. (Würzburg), Hon. LL.D. (Aberd.), B.Sc. (Lond.), F.R.S., A.R.S.M., F.I.C., The University, St. Andrews, N.B.
1901	Proc.		Purvis, John Edward, M.A. (Cantab.), A.R.C.S.I. F.I.C., University Chemical Laboratory, Cambridge
1906			Pye, Thomas Ebenezer, Clovelly, Chichester, Sussex
1886			Pyke, Lazarus S.M., Assoc.M.Inst.C.E., M.Inst.E.E., 10, Westbourne-terrace, Hyde Park, W.

Date of Election.			
1905			Pyman, Frank Lee, B.Sc. (Vict.), Ph.D. (Basel), The Oaks, Hitchin, Herts.
1905			Quant, Ernest, 2, Park-crescent, Torquay
1868			Quibell, Oliver, Shalem Lodge, Newark
1894			Quinn, Gerald Grattan, A.R.C.S., 8, Church-view, Norden, Rochdale
1901			Radcliffe, Lionel Guy, 6, Alma-terrace, Old Trafford, Manchester
1902			Ralphs, Edwin, Queen's College, Hong Kong
1897			Ralston, William, B.Sc. (Lond.), F.I.C., 3, Windsor-terrace, Linthouse, Govan, Glasgow
1892	Trans.		‖Ramage, Hugh, M.A. (Cantab.), A.R.C.S.I., F.I.C., Ridgemont, Carrow-hill, Norwich
1873	Trans.	C. 1886-9 V.P. 92-5, 1897-1900 F.S. 1902-	†‖Ramsay, Sir William, K.C.B., Ph.D. (Tübingen), Hon. LL.D. (Glas.), Hon. Sc.D. (Dub. and Cantab.), Hon. D.Sc., (Columbia), F.R.S., F.I.C., University College, W.C., and 19, Chester-terrace, Regent's Park, N.W.
1901			Ramsden, William Cecil, 107, Moyne-road, Rathmines, Dublin
1902			Ramshaw, Walter, Beech Cottage, Shaftesbury, Dorset
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1905			Ratcliffe, William Henry, B.Sc. (Lond.), 3, Dowanhill-gardens, Hither-green-lane, S.E.
1906			Rawles, Walter Hansen, 81, Lewisham High-road, S.E.
1880			‖Rawson, Christopher, F.I.C., 2, Melbourne-place, Bradford
1884	Trans.		‖Rawson, Sidney George, D.Sc. (Lond.), F.I.C., Red Hill House, London-road, Worcester
1898			Ray, John Armstedt, jun., B.A. (Dub.), 15, Nassau-street, Dublin
1902	Trans.		Rây, Prafulla Chandra, Prof., Presidency College, Calcutta
1889	Trans.		‖Read, Arthur Avery, F.I.C., 3, Fitzalan-place, Cardiff
1895			Read, Edwin James, B.A. (Cantab.), F.I.C., St. Ives, The Avenue, Gravesend, Kent
1899	Trans		Read, Harold McLean, 19, Baronsmead-road, Castlenau, Barnes, S.W.
1900			Readman, James Fraser, 8, Park-avenue, Glasgow
1890			Redding, Richard James, 29, Isla-road, Plumstead, Kent
1903			Redfern, Herbert Stanley, B.Sc. (Vict.), U.M.F.C. College, Ningpo, China
1892			Redman, Henry Ramsden, 60, Nelson-road, Gillingham, Kent
1866		C. 1891-2	Redwood, Sir Boverton, Hon. D.Sc. (Ohio), F.R.S.E., F.I.C., 4, Bishopsgate-street-within, E.C.

† Longstaff Medallist, 1897.

Date of Election.			
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, Theophilus Horne, F.I.C., 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D. (Berne), 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrsthof, 8, South Park-hill-road, South Croydon
1880			‖Regester, William, Lawn Lodge, Isleworth, Middlesex
1897			Reid, Alexander Ferguson, The Gold and Silver Extraction Co., Ltd., 208–210, McPhee Building, Denver, Col., U.S.A.
1893			Reid, Thomas Anderson, c/o Messrs. Johnsen, Jörgensen, and Wettre, 38, Victoria-buildings, Manchester
1881			‖Reid, Walter Francis, F.I.C., Fieldside, Addlestone, Surrey
1897			Remington, John Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1886			Remington, Joseph Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1879	Trans.		Rennie, Edward Henry, Prof., D.Sc. (Lond.), F.I.C., The University, Adelaide, S. Australia
1898	Proc.		Renwick, Frank Forster, Cromer Villa, Warley-road, Brentwood, Essex
1902	Trans.		Revis, Cecil, 77, King-street, Hammersmith, W.
1873	Trans.	V.P. 1881-4, 89-92, 97-1900. P. 1901-1903	Reynolds, James Emerson, Prof., Hon. Sc.D. and Hon. M.D. (Dub.), M.R.C.P. (Ireland), L.R.C.P. and S. (Edin.), F.R.S., F.I.C., 29, Campden Hill Court, Kensington, W.
1898	Trans.		Reynolds, William Colebrook, B.Sc. (Lond.), Roseleigh, Essex-road, Dartford, Kent
1898	Trans.		Rich, Edward Milton, 18, Manor-road, Forest Hill, S.E.
1903			Rich, Stiles William George, c/o Messrs. Thomason Chater, Ltd., Stanley-street, South Brisbane, Queensland
1889			Richards, Duncan Taylor, 57, Osborne-avenue, Westoe-lane, South Shields
1889			‖Richards, Edgar, c/o G. K. Richards, Esq., 16, Lafayette-square, Washington, D.C., U.S.A.
1905			Richards, Frederick George, 21, Dutton-street, Manchester
1889			‖Richards, Percy Andrew Ellis, F.I.C., 51, Rowan-road, Brook Green, W., and Charing Cross Hospital Medical School, W.C.
1886			Richards, William, B.Sc. (Lond.), The Clock House, Tooting, S.W.
1898			Richards, William, Flora Cottage, Eastbourne, Darlington
1885	Trans.		‖Richardson, Arthur, The Central Hindu College, Benares, N.W.P., India
1888	Trans.		‖Richardson, Clifford, Director, New York Testing Laboratory, Long Island City, New York, U.S.A.
1883			Richardson, Frederic William, F.I.C., Oak Lea, Menston, Leeds

Date of Election.			
1903			Richardson, Harold Ernest, B.A., B.Sc. (Lond.), 1, Penlee-view-terrace, Penzance, Cornwall
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert Naylor Bardsley, B.A. (Cantab.), 10, Friar-lane, Leicester
1866			Richardson, Joseph, Pansei View, Arran-avenue, Marsland-road, Sale, Manchester
1906			Richardson, Lawrence George, 14, Ash-grove, Horton, Bradford
1892			Richardson, Reginald Edensor Stanley, 10, Friar-lane, Leicester
1887	Trans.		Richmond, Henry Droop, F.I.C., 8, Woodfield-road, Ealing, W.
1902			Ricketts, Guy Dunstan, M.A. (Cantab.), The Grange, Staplefield, near Crawley, Sussex
1894			Riddick, David Gibson, Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc. (Lond.), F.I.C., 28, Victoria-street, Westminster, S.W.
1895			Ridge, W. T. B., 2, Ashwood-terrace, Longton, Staffs.
1882	Trans.		Ridsdale, Charles Henry, F.I.C., Ferndale, Linthorpe, Middlesbrough
1888			Rigby, John Samuel, 26, Bagot-street, Wavertree, Liverpool
1905			Rigby, Thomas, c/o Messrs. Crossley Bros., Ltd., Openshaw, Manchester
1898			Rigg, Gilbert, Mineral Point Zinc Co., Depue, Ill., U.S.A.
1851	Trans.	C. 1878-80	Riley, Edward, F.I.C., 14A, Finsbury-square, E.C.
1904			Riley, Louis John Eezekiel, A.I.C., 8, Newton-road, W.
1900			Riley, Walter Alfred, Hazeldene, College-road, Norwich
1893			Rintoul, William, F.I.C., Royal Gunpowder Factory, Waltham Abbey
1902			Roast, Harold James, Y.M.C.A., Montreal, Quebec, Canada
1893			Robbins, James Henry, B.Sc., 4, Selborne-road, Ilford, Essex
1897			Roberts, Ernest Henry, 81, Cicada-road, Wandsworth, S.W.
1883			‖Roberts, Frederick George Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899			Roberts, James, jun., 43, Great Western-road, Glasgow
1876			Roberts, Martin Fenn, General Post Office, E.C., and Mabshill, Epsom.
1889			Roberts, Richard Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894			Roberts, Thomas John, Ingleside, Park-road, Huyton, nr. Liverpool
1880			Roberts, William Brittain, Wilderspool House, Warrington, Lancs.
1894			Robertson, Archibald Blair, Struan, Giffnock, Glasgow
1904			Robertson, Franklin Ernest, Gloster House, Harders-road, Peckham, S.E.
1903			Robertson, Frederick, 128, Wellington-street, Glasgow

Date of Election.			
1903	Trans.		Robertson, Philip Wilfred, M.A. (N.Z.), Trinity College, Oxford
1901	Trans.		Robertson, William, 9, Thirsk-road, Lavender Hill, Battersea, S.W.
1889			Robins, Harry Hollis, c/o Messrs. Southwell and Co., Dockhead, S.E.
1903			Robinson, Archibald Louis, B.A. (Dub.), 40, Trinity College, Dublin
1896			Robinson, Henry Fishwick, M.Sc. (Vict.), 2, Richmond-street, Droylsden-road, Newton Heath, Manchester
1882	Trans.		‖Robinson, Henry Haliburton, M.A. (Oxon.), F.I.C., 75, Finborough-road, West Brompton, S.W.
1895			Robinson, Herbert Lewin, The Plating Co., 10, Kirby-street, Hatton-garden, E.C.
1901			Robinson, William Hammond, Ribblesdale, Cardiff-road, Llandaff, South Wales
1904			Rodger, Robert, 54, Rostrevor-road, S.W.
1898			Rofe, Henry John, M.A. (Oxon.), 8, Victoria-street, Westminster, S.W.
1883			Rogers, Arthur William, Tadcaster Tower Brewery Co., Tadcaster
1884			Rogers, Francis Murray, 21, Burma-road, Stoke Newington, N.
1905			Rogers, Harold Rudolf, B.A. (Oxon.), 25, King-street, Newcastle, Staffs.
1903			Rogers, William David, A.R.C.S., A.I.C., 36, Grange-road, Smethwick
1906	Trans.		Rogerson, Harold, M.Sc. (Manc.), 6, King-street, Snow Hill, E.C.
1894			Rolfe, John F., 50, South-street, Greenwich, S.E.
1903			Roose, Fitzroy Owen Jonathan, Assoc.Inst.E.E., 18, Vincent-square-mansions, Westminster, S.W.
1855	Trans.	C. 1860-4 1871-3. V.P. 73-5 1877-80. P. 80-2	Roscoe, Sir Henry Enfield, B.A., D.C.L., (Oxon.), LL.D. (Cantab., Dub., Glas., Montreal, Aberd.), Ph.D. and Hon. M.D. (Heidelberg), Hon. D.Sc. (Vict.), F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8	‖Rose, Thomas Kirke, D.Sc. (Lond.), 6, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D. (Würzburg), 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, F.I.C., 1, Glengall-road, Old Kent-road, S.E.
1905			Ross, Frederick Wilson Montrose, 21, Soho-square, W.
1902			Ross, George Archibald Park, M.B., Ch.B. and D.P.H. (Edin.), 69, Leamington-terrace, Edinburgh
1881			Ross, Henry, Rev., LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, Raymond St. George, F.I.C., Public Analyst, Burnley
1902			Ross, William Charles, Capt., I.M.S., M.B., Ch.B. and D.P.H. (Edin.), Deputy Sanitary Commissioner, Calcutta, India

Date of Election.			
1891	Proc.		Rossiter, Edmund Charles, F.I.C., 4, Park-road, West Smethwick, Birmingham
1896			Rostron, Harold, B.Sc. (Vict.), 699, Manchester-road, Bolton
1892			Rothwell, Charles Frederick Seymour, Beech Croft, Mobberley, Knutsford
1904			Rouillard, Marie Jean Louis Ernest, B.Sc. (Edin.), Malvern, Natal, South Africa
1899			Roundell, Christopher Foulis, B.A. (Oxon.), Lieut., Guards' Club, Pall Mall, S.W.
1900			Row, Mysore Chavan Nanjunda, B.A., M.B. and C.M. (Madras), Mylapore, Madras, India
1905			Rowland, James Frederick Fothergill, B.A. (Cantab.), 5, St. James'-park, Croydon
1905			Rowley, Henry, M.Inst.E.E., 81, Barrack-street, Perth, Western Australia
1906			Rowsell, Philip Foale, Nutbrook, Exmouth, S. Devon
1900			Roy, Mathura Goolab, Chintadirpetah, Madras, India
1901			Royle, Charles Leonard, c/o Messrs. Parry and Co., Madras, India
1905			Royle, Harold Marmion, 12, Barfield-villas, George-lane, South Woodford, Essex
1872	Trans.		Rufle, John, F.I.C., Musley, Ware, Herts.
1895			Rugginz, William Augustus, Strathmore, 1, Salisbury-road, Grove-road, Walthamstow, Essex
1889	Trans.	C. 1903-05	Ruhemann, Siegfried, M.A. (Cantab.), Ph.D. (Berlin), Gonville and Caius College, Cambridge
1883			Rumble, Charles, F.I.C., 9, Sangora-road, New Wandsworth, S.W.
1890			‖Russell, Edward, B.Sc. (Lond.), F.I.C., 18, Woodstock-road, Redland-green, Bristol
1899	Trans.		Russell, Edward John, D.Sc. (Lond.), S.E. Agricultural College, Wye, Kent
1901			Russell, James Bertram, B.Sc. (Lond.), 46, Spencer-avenue Wood Green, N.
1851	Trans.	C. 1863-7, 1870-2. V.P. 1872-3 S. 1873-5 T. 1875-89 P. 1889-91	‖Russell, William James, Ph.D. (Heidelberg), F.R.S., F.I.C., 34, Upper Hamilton-terrace, St. John's Wood, N.W.
1896			Rutter, Thomas Francis, B.Sc. (Lond.), 120, Upper Tulse Hill, S.W.
1894			Ryce, George, B.A. (R.U.I.), Irish Agricultural Offices of the Potash Syndicate, 50, Essex-street, Dublin
1901	Trans.		Ryffel, John Henry, M.A. (Cantab.), B.Sc. (Lond.), 10, Grasmere-road, Muswell Hill, N.

Date of Election.		
1888		‖Sach, Albert John, Technical College, Goulburn, N.S.W.
1868		Sadler, Sir Samuel Alexander, Col., Cleveland Chemical Works, Middlesbrough
1896		Sage, Charles Edward, 2, Charterhouse-street, E.C.
1879	Trans.	‖Sakurai, Joji, Prof. Science College, Imperial University, Tokio, Japan
1880		Salamon, Alfred Gordon, A.R.S.M., F.I.C., 1, Fenchurch-avenue, E.C.
1906		Salmon, Frederick John, c/o Miss Huber, 26, Fordhook-avenue, Ealing, W.
1876		‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells ; and Berkeley Chambers, 13, Bruton-street, Hyde Park, W.
1863		‖Salt, Henry, M.D. and C.M. (Edin.), Inglewood, Great Malvern
1871		‖Salter, Mortyn John, F.I.C., Greyrickhouse, Mickleton, Glos.
1859		‖Salter, Thomas William, 193, Priory-road, West-hill, Hastings
1902		Sampson, John William, Cleveland Pharmacy, Bath
1882		Samuel, William Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.
1898	Trans.	Sand, Henry Julius Salmon, Ph.D. (Zürich), University College, Nottingham
1870		‖Sandberg, Christer Peter, Palace-chambers, 9, Bridge-street, Westminster, S.W.
1900	Proc.	Sanders, James McConnell, c/o Direccion General de Aduanas, Mexico
1904		Sanders, Percy Richard, West Cliffe, Seaford, Sussex
1888		Sanderson, John, F.I.C., c/o Messrs. B. S. Cohen, Ltd., 15, Clerkenwell-close, E.C.
1901		Sandford, Thomas, 8, Market-street, Dalton-in-Furness
1882		Sanford, Percy Gerald, F.I.C., Laboratory, 20, Cullum-street, E.C.
1890		Saniter, Ernest Henry, Stratford Villa, Moorgate, Rotherham
1891		Sanyal, Abhayacharan, Prof., M.A. (Calcutta), Queen's College, Benares, N.W.P., India
1892		Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900		Sargeant, Fred Pilkington, College of Pharmacy, Clarendon-road, Leeds
1886		Saunders, William, Prof., Experimental Farm, Ottawa, Ontario, Canada
1903		Sawdon, Ernest William, B.Sc. (Vict.), 2, Esk-terrace, Whitby
1898		Sayer, Harold Charles, 51, Highfield-road, Dartford
1890		Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885		Scammell, Luther Robert, c/o Messrs. F. H. Faulding & Co., 54, King William-street, Adelaide, South Australia

Date of Election.			
1877			Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C. ; and 75, Oxford-road, Canonbury, N.
1897			Scargill, Lionel Walter Kennedy, B.A. (Oxon.), 5, Tenison-avenue, Cambridge
1893			Schidrowitz, Philip, Ph.D. (Berne), 57, Chancery-lane, W.C.
1888	Trans.		‖Schieffelin, William Jay, Ph.B. (Columbia), 840, Southern-boulevard, New York, U.S.A.
1905			Schnurmann, Harry Nestor-, c/o Messrs. Fraser and Chalmers, Ltd., Calle San Martin 195, 2, Piso, Buenos Ayres, South America
1892			‖Schofield, James Alexander, A.R.S.M., F.I.C., The University, Sydney, N.S.W.
1903			Scholefield, Alfred Henry, B.A. and B.Sc. (Lond.), 57, The Avenue, Leigh, Lancs.
1905	Trans.		Scholefield, Fred, B.Sc. (Lond. and Vict.), A.I.C., 9, Lyndhurst-villas, Magdalen-road, Norwich
1902			Scholes, William, Mount Sion, Radcliffe, Lancs.
1899	Trans.		Schryver, Samuel Barnett, D.Sc. (Lond.), Ph.D. (Leipzig), 27, Arundel-gardens, Notting Hill, W.
1896			Scotland, Peter Bain, c/o The Arizona Copper Co., Ltd., Metcalf Mines, Clifton, Arizona, U.S.A.
1879	Trans.	C.1897-9 S. 1899-1904 T. 1904-	‖Scott, Alexander, M.A. (Cantab.), D.Sc. (Edin.), F.R.S., F.I.C., Davy-Faraday Research Laboratory, 20, Albemarle-street, W., and 13, Neville-court, Abbey-road, N.W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, George Charlton, Bengal Iron and Steel Co., Ltd., Burrakur, Bengal, India
1905			Scott, John Irwin, M.A. (Oxon.), Trent College, Long Eaton, Derbyshire.
1906			Scouller, Walter Daly, B.Sc. (Vict.), Chester Corporation Sewage Purification Works, Chester
1883	Proc.		Scudder, Frank, F.I.C., 44, Mosley-street, Manchester
1906			Seaber, Willie Macro, B.Sc. (Lond.), Firdale, Sheen-lane, East Sheen, Surrey
1896			Seabrooke, Herbert Cecil, F.I.C., Black Ash, Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup, Kent
1890			Seaton, Edward Cox, M.D. (Lond.), M.R.C.S. (Eng.), F.R.C.P. (Lond.), F.I.C., 93, St. George's-square, S.W.
1905			Seaton, William Dunham, 40, Argyle-road, Ilford, Essex
1899			Seligman, Richard, Ph.D. (Heidelberg), A.C.G.I., 17, Kensington-palace-gardens, W.
1892	Trans	C. 1905-	Sell, William James, M.A., Sc.D., (Cantab.), F.R.S., F.I.C., University Chemical Laboratory, Pembroke-street, Cambridge
1875			Sellon, John Scudamore, 78, Hatton-garden, E.C.

Date of Election.			
1904	Trans.		Sen, Jatindranâth, M.A. (Calcutta), 71, Cathedral Mission-lane, Calcutta, India
1875	Trans.		‖Senier, Alfred, Prof., M.D. (Mich.), Ph.D. (Berlin), F.I.C., Queen's College, and Gurthard, Galway
1887			Senier, Harold, F.I.C., Hanley House, Ryde, Isle of Wight
1899			Senior, George, B.A. (Lond.), 109, Brynland-avenue, Bishopston, Bristol
1906			Senior, John, Sizing-hill, Batley Carr, Dewsbury
1903			Senter, George, Ph.D. (Leipzig), B.Sc. (Lond.), Chemical Laboratory, St. Mary's Hospital Medical School, Paddington, W.
1905			Setterington, Douglas Temple, 45, Regent-road, Blackpool, Lancs.
1896			Severn, Walter Dalrymple, A.R.C.S., Medical Officer of Health, Public Health Laboratory, Cape Town, South Africa
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.
1874			‖Sexton, Alexander Humboldt, Prof., F.I.C., F.R.S.E., Metallurgical Department, Andersonian-buildings, 204, George-street, Glasgow
1895			Seyler, Clarence Arthur, B.Sc. (Lond.), F.I.C., The Technical Institute, Nelson-terrace, Swansea
1904			Shacklady, Thomas George, Addiscombe-villas, Cliffe-at-Hoo, Rochester, Kent
1880			Shadwell, John Emilius Lancelot, F.I.C., Charlecote, Lansdown, Bath
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, Shirley Manor, Wyke, near Bradford
1895			Sharrott, Thomas Chilwell, B.A. (Dub.), A.R.C.S., F.I.C., Bovey Tracey School, Devon
1895	Trans.		‖Shaw, George Elliott, B.Sc. (Lond.), F.I.C., Assistant Quinologist, Mungpoo, Sonada, P.O., D.H. Railway, Bengal, India
1887			Sheard, John Tomlinson, Birley Carr, Sheffield
1905	Trans.		Shedden, Frank, B.Sc. (Lond.), F.I.C., 25, Hareholme-lane, Cloughfold, near Manchester
1899			Shelbourn, Edward Thomas, F.I.C., 40, Craven-street, Strand, W.C.
1904	Proc.		Shelton, Henry Stanley, B.Sc. (Lond.), 4, Larden-road, Acton Vale, W.
1876	Trans.	C. 1893-7	‖Shenstone, William Ashwell, F.R.S., F.I.C., 46, College-road, Clifton, Bristol
1897			Shenton, James Porter, 37, Torbay-road, Chorlton-cum-Hardy, near Manchester
1899	Trans.		Shepheard, William Frederick John, 12, Bridge-street-row, Chester
1906			Shepherd, Arthur Burton, B.Sc. (Vict.), F.I.C., c/o The British Oil and Cake Mills, Ltd., Copenhagen Mill, Limehouse, E.

Date of Election.		
1905		Shepherd, Charles Stuart, Rev., Worth Matravers Vicarage, Wareham, Dorset
1874		‖Shepherd, Harcourt Henry Benjamin, F.I.C., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899		Shepherd, John William, B.Sc. (Lond.), 5, Cleveland-avenue, Merton Park, S.W.
1901	Trans.	Sheppard, Samuel Edward, B.Sc. (Lond.), Physikal. Institut, Universität, Marburg, Germany
1901		Shepperson, William, The Pryors, East Heath-road, Hampstead, N.W.
1901		Sherwood, Edward Charles, Rev., M.A. (Oxon.), St. Peter's College, Westminster, S.W.
1891	Trans.	‖Shields, John, D.Sc. (Edin.), Ph.D. (Strassburg), F.I.C., 4, Stanley-gardens, Willesden Green, N.W.
1896		Shimomura, Kotaro, Prof., Osaka Seimi Works Co., Kawagishicho, Nishiku, Osaka, Japan
1894		Shorthouse, Herbert Stephen, 47, Pershore-road, Birmingham
1906		Shrimpton, John Kirby, 22, Fountain's-terrace, North-road, Ripon
1904		Shrubsole, Alfred, 18, Forest-drive-west, Leytonstone, N.E.
1886		Shutt, Frank Thomas, M.A. (Toronto), F.I.C., Experimental Farm, Ottawa, Canada
1890		Shuttlewood, Willis Brewin, 78, Whitehall-park, Hornsey-lane, Highgate, N.
1894		Shuttleworth, Edward Buckingham, Prof., 220, Sherborne-street, Toronto, Canada
1904		Siau, Raymond Louis, 15, Merridale-lane, Wolverhampton
1903		Sibley, Samuel Edward, Tottenham, Warren-road, Marrickville, Sydney, N.S.W.
1859		Sibson, Alfred, 23, St. Mary Axe, E.C.
1889		Sibson, Alfred Edward, 19, Carlingford-road, Hampstead, N.W.
1901		Sichel, Gerald Theodore Sylvester, F.R.C.S. (Eng.), L.R.C.P. (Lond.), Eastfield Lodge, Portsmouth-road, Guildford
1903		Siddle, George, Middleton-one-row, R.S.O., Co. Durham
1902	Proc.	‖Sidgwick, Nevil Vincent, M.A. (Oxon.), D.Sc. (Tübingen), Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D. (Würzburg), 51, Shooter's Hill-road, Blackheath, S.E.
1886		Silvester, Harry, Hon. B.Sc. (Birm.), F.I.C., 78, Holy Head-road, Handsworth, Birmingham
1899	Trans.	Simmonds, Charles, B.Sc. (Lond.), Northcroft, Deronda-road, Herne Hill, S.E.
1889		Simmonds, Henry, Engineer's Office, Gas Works, and Elton View House, Bury, Lancs.
1887		‖Simmons, Leonard Owen, 360, Coldharbour-lane, Brixton, S.W.

Date of Election.		
1905		Simmons, William Herbert, B.Sc. (Lond.), Oakleigh, Stoke Newington Common, N.
1895		Simons, Albert Joseph, c/o M. Simons, Esq., 31, Little Britain, E.C.
1896		Simpson, Aitken Migget, 364, Stanstead-road, Catford, S.E.
1902		Simpson, Duncan Ivan Rennard, P.O. Box 4225, Johannesburg, Transvaal, South Africa
1897		Simpson, Edward Sydney, B.E. (Sydney), Geological Survey Laboratory, Museum-street, Perth, West Australia
1886	Proc.	‖Simpson, William Selby, F.I.C., 17, Lake Side-road, Palmer's Green, N.
1902	Proc.	Sindall, Robert Walter, 201, Wellmeadow-road, Catford, S.E.
1889		Singer, Ignatius, 3, Parkfield-road, Manningham, Bradford
1902	Proc.	Sinnatt, Frank Sturdy, Glenside, Church-lane, Moston, Manchester
1896		‖Sircar, Amrita Lal, 51, Sankaritola, Calcutta, India
1902		Skertchly, William Pearson, F.I.C., 11, Billiter-square, E.C.
1888	Trans.	Skinner, Sidney, M.A. (Cantab.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1899	Trans.	Skirrow, Frederick William, M.Sc. (Vict.), Ph.D. (Leipzig), 17, Curzon-avenue, Victoria-park, Manchester
1892		Skurray, Thomas, United Breweries, Abingdon, Berks
1879		Slater, Charles, M.A. and M.B. (Cantab.), M.R.C.S. (Eng.), 81, St. Ermin's-mansions, Westminster, S.W.
1880	Trans.	‖Slater, Harold Humboldt, F.I.C., St. Lawrence, Borstal-road, Rochester, Kent
1903	Trans.	Slator, Arthur, Ph.D. (Leipzig), M.Sc. (Birm.), B.Sc. (Lond.), F.I.C., The Priory, Burton-on-Trent
1878		‖Slatter, George William, A.R.C.S.I., F.I.C., 241, Carlton-terrace, Nab Wood, Shipley, Yorks.
1895		Slocum, Frank Leroy, 401, South Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		‖Smetham, Alfred, F.I.C., Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1898	Trans.	Smiles, Samuel, D.Sc. (Lond.), University College, Gower-street, W.C.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	‖Smith, Alexander, Prof., Ph.D. (Munich), B.Sc. (Edin.), University of Chicago, Chicago, Ill., U.S.A.
1901		Smith, Andrew Biggam, c/o M. Armstrong, Esq., P.O. Box 90, Queenstown, Cape Colony, South Africa
1888		Smith, Angus, F.I.C., 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, Benjamin Jordan, 58, King's-road, Reading, and 9, Broxtowe-drive, Mansfield, Notts.
1903		Smith, Charles Joseph, Sunnydale, Walton New-road, Stockton Heath, near Warrington

Date of Election.		
1904	Trans.	Smith, Clarence, D.Sc. (Lond.), Aldersyde, Harpenden-road, Wanstead Park, E.
1894	Trans.	Smith, Claude, F.I.C., Barngarth, Cartmel, Carnforth
1884		‖Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1900		Smith, Edward Shrapnell, 4, Raymond-buildings, Gray's Inn, W.C.
1906		Smith, Frank, B.Sc. (Vict.), 407, Church-road, Smithills, Bolton
1903		Smith, Frank Gurney, The University of Manitoba, Winnipeg, Canada
1892		‖Smith, Fred, Newland Cottage, Garden-street, Rosettenville, Johannesburg, South Africa
1906		Smith, Fred, Cliff House, Bruntcliffe, Leeds
1874		Smith, George, Nobel's Explosives Co., Polmont Station, N.B.
1896		Smith, George Egerton Scott, F.I.C., 67, Surrey-street, Sheffield
1892		‖Smith, George Percy Darnell-, B.Sc. (Lond.), F.I.C., The Merchant Venturers' Technical College, Bristol
1904		Smith, Gerald Oscar Morgan-, Watton-road, Swaffham, Norfolk
1901		Smith, Henry Ewing, 22, City-road, E.C.
1896	Trans.	Smith, Henry George, The Technological Museum, Sydney, N.S.W.
1904		Smith, Henry Heron, F.I.C., 76, Plumstead-common-road, Plumstead, Kent
1878		Smith, Henry Russell, F.I.C., 1, Aubert-park, Highbury, N.
1900		‖Smith, Herbert Procter, Shotton-lane, Shotton, Flints.
1890		Smith, Harry Wood, B.Sc. (Vict.), c/o Messrs. John Batt and Co., Ltd., 39, Old Broad-street, E.C.
1901		Smith, James, 80, Ampthill-road, Aigburth, Liverpool
1903		Smith, James Cruickshank, B.Sc., 5, The Elms, London-road, Wembley, R.S.O., Middlesex
1879		Smith, John William, 7, Brookfield-street, Roslindale, Boston, Mass., U.S.A.
1902		Smith, Leonard, Hillside, Park-hill-road, Croydon
1901	Trans.	Smith, Norman, D.Sc. (Vict.), The University, Manchester
1902		Smith, Robert Ely Blake, B.Sc. (Lond.), A.I.C., 31, St. John's-road, Putney, S.W.
1897		Smith, Robert Francis Wood, 90, Lower Thames-street, E.C.
1891		Smith, Robert Greig-, D.Sc. (Edin.), M.Sc. (Dun.), Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1888		Smith, Samuel, Hillsboro', Goddard-avenue, Old Swindon
1904		Smith, Samuel John, 41, Grafton-street, Dublin
1876		‖Smith, William Alexander, M.A. and M.B. (Oxon.), M.R.C.S. (Eng.), Newport, Essex
1866	Trans.	Smith, Watson, F.I.C., 34, Upper-park-road, Haverstock Hill, N.W.
1903		Smith, William Veysey, B.A. (Oxon.), 81, Surrey Street, Norwich

Date of Election.			
1883	Trans.	C. 1896-1900 V.P. 1905-	‖Smithells, Arthur, Prof., B.Sc. (Lond.), F.R.S., F.I.C., The University, Leeds
1873			‖Smyth, John, M.A. (Dub.), M.Inst.C.E., Milltown, Banbridge, Ireland
1902			Smythe, John Seabury, B.Sc. (Vict.), Ph.D. (Würzburg), Rantallard, Lance-lane, Wavertree, Liverpool
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc. (Lond.), Ph.D. (Göttingen), F.I.C., Balholm, Lathom-road, Southport
1899	Trans.		Soddy, Frederick, M.A. (Oxon.), Chemical Department, The University, Glasgow
1896	Trans.		Sodeau, William Horace, D.Sc. (Lond.), F.I.C., 19, East-parade, Newcastle-on-Tyne
1887			Sohn, Charles Emile, F.I.C., 2, Harpur-street, Bedford-row, W.C.
1891			Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1906			Sommerville, David, B.A. (R.U.I.), M.D., B.Ch., and D.P.H. (Cantab.), M.R.C.P. (Lond.), 31, Manor House, Marylebone-road, N.W.
1874	Trans.		Sonstadt, Edward, Church Field, Cheshunt, Herts.
1893			Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875			Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897	Proc.		Southerden, Frank, B.Sc. (Lond.), F.I.C., Royal Albert Memorial College, Exeter
1897			Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902			Southworth, William, Agricultural and Horticultural College, Uckfield, Sussex
1883			Soward, Alfred Walter, 28, Therapia-road, Honor Oak, S.E.
1892			Spackman, Charles, Rosehaugh, Clitheroe, Lancs.
1905			Speight, William Ewart, Corporation Sewage Works, Deighton, Huddersfield
1901			Spence, John Davidson, c/o Messrs. Cannon and Newton, 39, Mincing-lane, E.C.
1883			‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1906	Trans.		Spencer, James Frederick, M.Sc. (L'pool), B.Sc. (Vict.), Ph.D. (Breslau), 126, Gower-street, W.C.
1886			Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887			‖Spencer, Walter Shelley, Lyndene, Darley-grove, Farnworth, near Bolton
1894			Spenzer, John George, Prof., M.D., Ph.D. (Strassburg), Ohio Wesleyan University, 261, Amesbury-avenue, Cleveland, Ohio, U.S.A.
1904			Spielmann, Percy Edwin, B.Sc. (Lond.), A.R.C.S., A.I.C., 21, Cadogan-gardens, S.W.

Date of Election.		
1859	Trans.	‖Spiller, John, F.I.C., 2, St. Mary's-road, Canonbury, N.
1863		‖Spiller, William, F.I.C., 2, Lindfield-gardens, Hampstead, N.W.
1885		‖Spottiswoode, William Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1906	Trans.	Sproxton, Foster, B.Sc. (Lond.), Brantham Works, near Manningtree, Essex
1882		‖Squire, Peter Wyatt, 413, Oxford-street, W.
1892		Squires, Alfred James, Greenbank, Coroner's-lane, Farnworth, Widnes, Lancs.
1877		Stacey, Henry George, 300, High Holborn, W.C.
1899		Stainer, John Ward, 103, Cheriton-road, Folkestone
1879	Trans.	‖Stallard, George, M.A. (Oxon.), Horton-crescent, Rugby
1904		Stanger, Reginald Harry Hursthouse, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W.
1902		Stanger, William Charles South, Ambleside, Corder-road, Ipswich
1904		Stanley, Harry, B.Sc. (Lond.), The Merchant Venturers' Technical College, Bristol
1887		‖Stansell, Lionel William, F.I.C., 7, Albion-place, Maidstone, Kent
1895		‖Stansfield, Alfred, D.Sc. (Lond.), McGill University, Montreal, Canada
1902		Stansfield, Edgar, M.Sc. (Vict.), The Laboratory, Dominion Iron and Steel Co., Ltd., Sydney, C.B., Nova Scotia
1899		Stansfield, Samuel, B.Sc. (Vict.), 2, Park-road, Batley, Yorks.
1900	Trans.	Stapleton, Henry Ernest, Prof., B.A. and B.Sc. (Oxon.), Presidency College, Calcutta, India
1870		Starey, Arthur John, 39, Woodland-gardens, Highgate, N.
1870	Trans.	‖Stark, James Fleming, Rosedale, Bromborough, Cheshire
1902		Stead, Francis Bernard, Clifton College, Bristol
1896		Stead, John Christopher, 1, Finsbury-circus, E.C.
1882	Trans.	Stead, John Edward, F.R.S., F.I.C., 11, Queen's-terrace, Middlesbrough
1897		Steel, Frederick William, c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Victoria
1885		Steel, Robert Elliot, County School, Northampton
1890		Steel, Thomas, c/o Colonial Sugar Refining Co., O'Connell-street, Sydney, N.S.W.
1900	Trans.	Steele, Bertram Dillon, D.Sc. (Melbourne), The University, Melbourne, Australia
1905		Steger, James, B.Sc. (Lond.), 111, Chesterfield-road, Bristol
1898		Steinhart, Oscar Julian, Ph.D. (Erlangen), c/o Messrs. Steinhart, Vogel and Cloud, Highfield Works, Feltham, R.S.O., Middlesex
1901		Stell, Samuel Fenton, 25, Henry-street, Keighley
1892	Trans.	‖Stenhouse, James, View-park-gardens, Bonnyrigg, Midlothian, N.B.

Date of Election.			
1884			Stenhouse, Thomas, F.I.C., Townhead, Rochdale
1905			Stennitt, Sydney Dockeray, M.Sc. (Vict.), Holcroft, Edgeley-road, Whitchurch, Salop
1895	Trans.		Stephens, Frank Robert, c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880			‖Stephens, Henry Charles, Cholderton, Salisbury
1897			Stephens, Michael Edmund, 57, Aldersgate-street, E.C.
1895			Stephenson, Herbert Frederick, A.R.C.S., Fairhaven, Lucien-road, Tooting Common, S.W.
1902			Stephenson, Robert, jun., M.A. (Cantab.), Burwell, Cambridge
1891	Trans.		Stephenson, Thomas, 137, George-street, Edinburgh
1888	Trans.		Stern, Arthur Landauer, D.Sc. (Lond.), F.I.C., Southbank, Stapenhill, Burton-on-Trent
1896			Steuart, Douglas Stuart Spens, B.Sc. (Vict.), The Royal Societies Club, St. James's-street, S.W.
1903	Trans.		Steven, Alec Bowring, B.Sc. (Lond.), The University, Leeds
1905			Stevens, Edmund Henry, Haw House, Rothbury, Northumberland
1905			Stevens, Harold Blythen, 225, Oxford-street, W.
1897	Trans.		Stevens, Henry Potter, M.A. (Oxon.), Ph.D. (Heidelberg), F.I.C., 15, Borough, London Bridge, S.E.
1903			Stevens, Montague White, A.R.C.S., A.I.C., H.M. Patent Office, 25, Southampton-buildings, W.C.
1899			Stevenson, Arnold, B.A. (Cantab.), 4, Porchester-gardens, W.
1903	Trans.		Stevenson, Henry Edward, 155, Coventry-road, Ilford, Essex
1904			Stevenson, Henry Ernest, Avondale, Ditton Hill, Surrey
1864		C. 1872-5 86-8, 94-7 V.P. 1900-03.	Stevenson, Sir Thomas, M.D. and F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1903	Trans.		Stewart, Alfred Walter, B.Sc. (Glas.), 53, Shaftesbury-road, Ravenscourt Park, W., and 18, Annfield-terrace, Partickhill, Glasgow
1902			Stewart, Hector, c/o Standard Bank of South Africa, Ltd., 10, Clement's Inn, E.C.
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, William Frederick Keating, F.I.C., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcs.
1887			Stocks, Herbert Birtwhistle, F.I.C., 12, Victoria-road, West Kirby, Cheshire
1894	Trans.		Stoddart, Frederick Wallis, F.I.C., Grafton Lodge, Sneyd Park, Bristol
1879	Proc.		‖Stokes, Alfred Walter, F.I.C., Vestry Hall, Paddington, W.

Date of Election.		
1873		‖Stone, Edward Daniel, Ackersley, Cheadle Hulme, near Stockport, Cheshire
1895		Stone, George, Esk Brewery, Launceston, Tasmania
1875		‖Stone, John Frederic Matthias Harris, M.A. (Cantab.), Barrister-at-Law, 4, Temple, E.C.
1879		‖Stone, William, M.A. (Cantab.), Oxford and Cambridge, Garrick, Bath, Union and Reform Clubs, and 63, Curzon-street, Mayfair, W.
1906		Storey, Francis Wylie, B.Sc. (Lond.), 42, Ellerdale-street, Lewisham, S.E.
1900		Storr, Bertram Vincent, B.Sc. (Vict.), 61, Balfour-road, Ilford, Essex
1887		‖Strangman, James Pim, 38, Rue Desbordes-Valmore, Paris-Passy, France
1904	Trans.	Streatfeild, Frederick Henry, 9, Crescent-road, South Tottenham, N.
1906		Streimer, Emanuel George, Park House, Margery-park-road, Forest Gate, E.
1900		Strong, Archie Hugh, 63, Herne-hill-road, Camberwell, S.E.
1904	Trans.	‖Struthers, Robert de Jersey Fleming-, M.A. and B.Sc. (Oxon.), Exeter College, Oxford
1885	Trans.	‖Stuart, Charles Maddock, M.A. (Cantab.), F.I.C., St. Dunstan's College, Catford, S.E.
1897	Trans.	Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1893		Styles, Robert Curling, A.R.S.M., F.I.C., Knockhall, Greenhithe, Kent
1890	Trans.	‖Sudborough, John Joseph, Prof., D.Sc. (Lond.), Ph.D. (Heidelberg), F.I.C., University College of Wales, Aberystwyth
1878	Trans.	‖Suguira, Shigetake, c/o Tokyo Chemical Society, Science College, Imperial University, Tokyo, Japan
1897		Sumner, Leonard, B.Sc. (Vict.), Butt Hill, Prestwich, near Manchester
1904		Sutcliffe, Thomas, 1, Swires-road, Boulevard, Halifax, Yorks
1887		‖Sutherland, David Alexander, F.I.C., 13, Victoria-street, Westminster, S.W.
1860		Sutton, Francis, F.I.C., Laboratory, Bank Plain, Norwich
1886		‖Sutton, Francis Napier, F.I.C., 6, Grosvenor-gardens, Willesden Green, N.W.
1902		Swain, James, 17, Winsham-street, West-side, Clapham Common, S.W.
1875		Swan, Sir Joseph Wilson, Hon. M.A. and Hon. D.Sc., (Dun.), F.R.S., F.I.C., 58, Holland-park, W.
1905		Swann, Robert Reed, B.Sc. (Dun.), The Lookout, Seaton Delaval, Northumberland
1894		‖Swinburne, James, F.R.S., 82, Victoria-street, S.W.

Date of Election.			
1891			Sykes, Matthew Carrington, M.D. (Dun.), F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. and D.P.H. (Lond.), Sykeshurst, Barnsley, Yorks.
1880			Symons, Brenton, Burwood, Warminster-road, South Norwood, S.E.
1874	Trans.		‖Symons, William Henry, M.D. (Brussels), D.P.H. (Oxon.), M.R.C.S. (Eng.), F.I.C., Health Office, Guildhall, Bath
1899	Trans.		Szarvasy, Charles Emerique, Ph.D. (Buda Pesth), Muegyetem VIII, Budapest, Hungary
1881	Trans.		‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokio, Japan
1887	Trans.		‖Takamine, Jokichi, 521, West 179th-street, New York, U.S.A.
1906			Talbot, George Stanley, c/o Pacific Phosphates Co., 68, Pitt-street, Sydney, N.S.W.
1901			Tankard, Arnold Rowsby, 82 Llanthewy Road, Newport, Mon.
1894			Tanner, Alfred Edward, Westminster Hospital, S.W.
1901			Tatam, George William Gerald, Cragleigh, Washwood-heath-road, Birmingham
1890			Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.		Tate, George, Ph.D. (Würzburg), F.I.C., Windsor Buildings, George-street, Liverpool.
1884			‖Tate, Walter, The Woodlands, Twerton-on-Avon, Bath
1890			Tate, William, Prof., Civil Engineering College, Sibpur, near Calcutta, India
1867			Tatlock, Robert Rattray, F.I.C., 11, Bellshaugh-road, Kelvinside West, Glasgow
1894			Taylor, Albert, 16, Wellington-grove, Stockport
1882			Taylor, Gotfred Midgley, 27, Great George-street, Westminster, S.W.
1894			Taylor, Herbert John, 52, Alexandra-crescent, Dewsbury
1880			‖Taylor, James, B.Sc. (Manc.), A.R.S.M., Nymagee, New South Wales
1891			Taylor, John, 15, Lucius-street, Torquay
1888			Taylor, John George, 3, Outram-street, Stockton-on-Tees
1905			Taylor, John William, University College, Reading
1874	Trans.		‖Taylor, Robert Llewellyn, F.I.C., 4, St. Werburgh's-road, Chorlton-cum-Hardy, Manchester
1901			Taylor, William Henry, B.Sc. (Lond.), F.I.C., 20, Balcaskie-road, Eltham Park, Kent
1878			‖Tcherniac, Joseph, Ph.D. (Zürich), c/o South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1879	Trans.		‖Teed, Frank Litherland, D.Sc. (Lond.), F.I.C., 9, Mincing-lane, E.C.
1906			Tempany, Harold Augustine, B.Sc. (Lond.), A.I.C., St. Johns, Antigua, British West Indies

Date of Election.			
1901			Templeman, William Henry, 67, Park-street, Spring Bank, Hull
1894			‖Terry, Edwin, 374, Brixton-road, S.W.
1881			Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893			Thackrah, James Robert, M.A. (Oxon.), Ph.D. (Leipzig), Technical Schools, Tavistock-road, Plymouth
1895			Theodosius, Alfred Fletcher, M.A. (Oxon.), University College, Oxford
1904			Thibault, Paul John, Howell, New South Wales
1899			Thiersch, Harry Alexander, 8, Clifton-gardens, Maida Vale, W.
1901			Thomas, Albert Edward, B.Sc. (Lond.), F.I.C., Science and Technical Schools, Barrington-street, Tiverton, Devon
1871			‖Thomas, Charles, J.P., Stoke Bishop, near Bristol
1905			Thomas, George Devenish, B.Sc. (Lond.), 18, Randolph-gardens, Dover
1874			Thomas, Harry Edgecumbe, Rockleaze Point, Clifton, Bristol
1875	Trans.		‖Thomas, Joseph William, F.I.C., Overdale, 6, Kingswood-road, Shortlands, Kent
1877			‖Thompson, Beeby, 67, Victoria-road, Northampton
1904			Thompson, Charles Herbert, Hillcroft, Amblecote, Stourbridge
1886	Trans.		‖Thompson, Claude Metford, Prof., M.A. (Cantab.), D.Sc. (Lond.), University College, and 38, Park-place, Cardiff
1894			Thompson, Edward Cumming, 32, Ulundi-road, Westcombe Park, S.E.
1893			Thompson, Frank Ernest, A.R.C.S., A.I.C., 51, Lichfield-road, Walsall
1893			Thompson, George Roos, The Laboratory, 69, Dock-street, Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1904			Thompson, Hubert, B.Sc. (Vict.), Agricultural College, Holmes Chapel, Cheshire
1886			Thompson, William Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1903			Thomson, George Malcolm, Newington, Dunedin, New Zealand
1872	Trans.	C. 1880-3, 1904-06. S. 1883-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., Hon. LL.D. (Glas.), F.R.S., F.I.C., King's College, W.C., and 9, Campden Hill-gardens, W.
1899			Thomson, Robert Tatlock, F.I.C., 156, Bath-street, Glasgow
1872			Thomson, William, F.I.C., Royal Institution Laboratory, Manchester
1895			Thomson, William Thomas, Oxford-villas, Waltham Abbey
1882	Trans.		Thorne, Leonard Temple, Ph.D. (Würzburg), F.I.C., 2, Denbigh-gardens, Richmond, Surrey

Date of Election.			
1906			Thornton, Percy Charles, 97, Garmoyle-road, Sefton-park, Liverpool
1906			Thorp, Arthur William, 210, Sherborne-road, Yeovil
1891			Thorp, Walter, B.Sc. (Lond.), F.I.C., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph.D. (Heidelberg), M.Sc. (Manc.), The University, Manchester
1871	Trans.	C.1879-83 V.P. 84-7 T. 89-99 P. 1899-1901	†‖Thorpe, Thomas Edward, Prof., C.B., D.Sc. (Vict.), Sc.D. (Dub.), Ph.D. (Heidelberg), LL.D. (Glas.), F.R.S., Government Laboratory, Clement's Inn-passage, W.C.
1899			Threlfall, Richard, Prof., M.A. (Cantab.), F.R.S., Assoc.M.Inst.C.E., 30, George-road, Edgbaston, Birmingham
1880			Thwaite, Benjamin Howarth, 29, Great George-street, Westminster, S.W.
1895			Tibbals, W. I., 187, Canton-avenue, Detroit, Mich., U.S.A.
1897	Trans.		Tickle, Thomas, B.Sc. (Lond.), F.I.C., 83, Queen-street, Exeter
1902			Tidy, Henry Letheby, B.A. (Oxon.), 15, Adam-street, Portman-square, W.
1903			Tighe, Arthur, Springfield, Darlinghurst-road, Sydney, N.S.W.
1903			Tilburn, Charles, c/o The Australian Explosives and Chemical Co., Ltd., Deer Park, Victoria, Australia
1865	Trans.	C.1878-81 V.P. 85-8 91-4, 96-9 T. 1899-03 P.1903-05	‖Tilden, William Augustus, Prof., D.Sc. (Lond.), Hon. Sc.D. (Dub.), Hon. D.Sc. (Vict.), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.; and The Oaks, Northwood, Middlesex
1900			Tilley, James Walter, 95a, Southwark-street, S.E.
1905			Tillott, John Booty, 55, Wood-street, Westminster, S.W.
1902			Tindall, Arthur Lea Butler, M.A. (Cantab.), Dagnall, Bakewell
1904	Trans.		Tingle, Alfred, B.Sc. (Lond.), Ph.D. (Penn.), Chinanfu, Shantung, China
1889	Trans.		‖Tingle, John Bishop, Ph.D. (Munich), Johns Hopkins University, Baltimore, U.S.A.
1898			Tisdale, Charles William Walker, University College, Reading
1905	Trans.		Titherley, Arthur Walsh, D.Sc. (Vict. L'pool.), Ph.D. (Heidelberg), Southcot, Moreton, near Birkenhead
1891			Tocher, James Fowler, F.I.C., 1, Chapel-street, Peterhead
1903			Tolson, Stanley, 248, Kingsbury-road, Birmingham
1900			Tomlins, George Edward, Rodney, St. John's-road, Leatherhead, Surrey
1884	Trans.		‖Tompson, Frederick William, Chemical Department, King's College, Strand, W.C.
1877			‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1904			Tong, Walter, Holmdene, Pole-lane, Failsworth, Manchester

† Longstaff Medallist, 1881.

Date of Election.		
1904		Tonkin, Arnold Bertram, Government Laboratory, Durban, Natal, South Africa
1906		Tonkin, Ronald William, 37, Oak-hill-road, Putney, S.W.
1893		‖Towers, John William, Victoria-road, Widnes
1903		Toyne, Francis Digby, B.A. (Cantab.), 270, Spotland-bridge, Rochdale, Lancs.
1901		Tozer, Herbert Ackerman, B.A. (Lond.), Jesmond, Edith-road, Selhurst, S.E.
1887		‖Traphagen, Frank W., Prof., Ph.D. (New York), Colorado School of Mines, Golden, Colorado, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris William, Prof., D.Sc. (Lond.), F.R.S., Indian Institute of Science, Bangalore, India; and c/o Messrs. Jeremiah Lyon and Co., 4, Lombard-court, E.C.
1906		Treble, Richard Lumley, B.Sc. (Dun.), 2, Rectory-terrace, Gosforth, Newcastle-on-Tyne
1895		Trehärne, Frederick Gwilym, Wrangbrook, Llanishen, near Cardiff
1888		‖Trewby, Herbert, 62, St. John-street, E.C.
1881		‖Trigger, Oliver, F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1902		Trimen, Stephen Herbert, Survey Dept., Finance Ministry, Giza, Egypt
1897		Tripp, Edward Howard, Ph.D. (Marburg), The Modern School, Bedford
1905		Troye, Gustave Arthur, P.O. Box 2706, Johannesburg, South Africa
1905	Trans.	Tuck, William Bradshaw, B.Sc. (Lond.), University College, Gower-street, W.C.
1898	Trans.	Tucker, Samuel Auchmuty, Ph.B. (Columbia), Columbia University, New York, U.S.A.
1889		Tucker, Willis Gaylord, M.D. (Albany), Ph.D. (Union Univ.), Medical College, Albany, New York, U.S.A.
1896		Tuckett, James Edwin Shum, M.A. (Cantab.), Marlborough College, Wilts.
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancs.
1902		Tunnicliffe, William Wright, B.Sc. (Lond.), Sunnyside, Newhall, Burton-on-Trent
1897	Trans.	Turnbull, Andrew, Ph.D. (Heidelberg), 3, Lord-street, Liverpool
1906		Turnbull, Robert Hutchison, F.I.C., c/o Messrs. MacAndrews and Forbes Co., 3rd-street and Jefferson-avenue, Camden, N.J., U.S.A.
1903		Turner, Arnold, 84, Molesworth-street, Rochdale
1886		Turner, Arthur, The Limes, Aylesbury
1896		Turner, Benjamin Bernard, B.Sc. (Lond.), Ph.D. (Göttingen), Connecticut Agricultural College, Storrs, Conn., U.S.A.

Date of Election.		
1897		Turner, Basil William, Wood's-chambers, 5, Moore-street, Sydney, N.S.W.
1888	Trans.	Turner, Charles, 225A, Oxford-street, Manchester
1906		Turner, George Augustus, Alma House, Strandtown, Belfast
1897		Turner, John Scriven, 20, Bury-street, Bloomsbury, W.C.
1902		Turner, Lyon Viccars, Crescent Lodge, St. John's, S.E.
1883	Trans.	‖Turner, Thomas, Prof., M.Sc. (Vict.), A.R.S.M., F.I.C., The University, Birmingham
1903	Trans.	Turner, William Ernest Stephen, M.Sc. (Birm.), B.Sc. (Lond.), The University, Sheffield
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab.), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robert, Albion House, The Marina, Deal
1905	Trans.	Tutin, Frank, 49, The Avenue, Kew, Surrey
1888	Trans.	Tutton, Alfred Edwin Howard, M.A. and D.Sc. (Oxon.), F.R.S., 41, Ladbroke-square, W.
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1904	Trans.	Twiss, Douglas Frank, M.Sc. (Birm.), A.I.C., The Municipal Technical School, Suffolk-street, Birmingham
1899	Trans.	Tyler, Ernest Albert, B.A. (Cantab.), 33, The Promenade, Mount Pleasant, Swansea
1876		Typke, Paul George William, F.I.C., Lawn House, New Malden, Surrey
1876		Tyrer, Thomas, F.I.C., Stirling Chemical Works, Abbey-lane, Stratford, E.
1903		Tyrrell, Dennis, 182, King-street, Norwich
1876		‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffs.
1865		Umney, Charles, F.I.C., 50, Southwark-street, S.E.
1893	Trans.	Umney, John Charles, 50, Southwark-street, S.E.
1889		‖Underhill, Thomas John, Stanley, Quernmore-road, Bromley, Kent.
1904		Underhill, William Wood, 10, Hartham-road, Holloway, N.
1897		‖Unwalla, Rustomji Navroji, Medical Dept., Bhaunagar, Kathiawâr, India
1882		‖Vacher, Francis.
1890		Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1903		Van Laer, Norbert, c/o Messrs. Truman, Hanbury, Buxton and Co., Ltd., Burton-on-Trent
1901		Varley, Harold Foy Fleetwood, 27, Northbourne-avenue, Morpeth, Northumberland

Date of Election.			
1883			Vasey, Samuel Archibald, F.I.C., Beechcroft, Burnt Ash-lane, Bromley, Kent
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor Herbert, M.A. and D.Sc. (Oxon.), F.R.S., 20, Bradmore-road, Oxford
1891			Velling, Frederick William de, B.A., Higher Grade Board School, The Boulevard, Hull
1881			Venable, Francis Preston, Ph.D. (Göttingen), Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas José Maria, Apartado No. 237, Bogotá, Colombia
1901			Verteuil, Joseph de, Clarence-street, Port of Spain, Trinidad, British West Indies
1897			Viccajee, Framjee Khurshedjee, H.H. The Nizam's Mint, Hyderabad, Deccan, India
1897			Vinter, Percy John, M.A. (Cantab.), 33, Lynton-road, Acton, W.
1884			‖Voelcker, Edward William, A.R.S.M., F.I.C., 22, Tudor-street, Blackfriars, E.C.
1884		C.1891-5 1902-04	‖Voelcker, John Augustus, Hon. M.A. (Cantab.), Ph.D. (Giessen), B.A. and B.Sc. (Lond.), F.I.C., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖Voss, Walter Arthur, Eastwood-road, Rayleigh, Essex
1885			Vulté, Hermann T., Ph.D., Columbia University, New York City, U.S.A.
1901			‖Wade, Frank, A.R.C.S., F.I.C., 76, Beach Farm-road, Southsea, and Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.	C. 1905-	‖Wade, John, D.Sc. (Lond.), F.I.C., 7, Trinity-square, Southwark, S.E., and Guy's Hospital, London Bridge, S.E.
1903	Trans.		Wadmore, John Mello, M.A. (Oxon.), Aldenham School, near Elstree, Herts.
1901			Wager, Morton Ethelred, B.Sc. (Lond.), Holme Cottage, Mytholmroyd, Yorks.
1894			‖Wagner, William George, Glyndhurst, Ealing Common, W.
1884			Wainwright, John Howard, Ph.D. (Columbia), Room 1210, 60, Wall-street, New York City, U.S.A.
1893			Wait, Charles E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			‖Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada
1899			Walden, Allan Frederick, M.A. (Oxon.), 37, High-street, and New College, Oxford
1897			Walford, Samuel Matthew, Wyncote, Hatherlow, Stockport
1868			‖Walker, Alexander, Major-General, R.A., C.S.I., 5, Montague-place, Russell-square, W.C.

Date of Election.			
1881			‖Walker, Archibald, M.A. (Oxon.), F.I.C., 7, Crown-terrace, Dowanhill, Glasgow
1898	Trans.		Walker, Andrew Jamieson, Ph.D. (Heidelberg), B.A. (Dub.), Municipal Technical College, Derby
1900			Walker, Augustus John, 1, Linton-road, Hastings
1899			Walker, Charles, c/o T. B. Walker, Esq., School of Mines, Charters Towers, Queensland, Australia
1894	Trans.		Walker, Charles Henry Hirst, M.A. (Oxon.), Secondary School, Oldbury, Birmingham
1889			Walker, Daniel, School of Mines, Ballarat, Victoria, Australia
1906			Walker, Franklin Wilfred, 39, Graham-road, Acton-green, W.
1890	Trans.	C. 1899-04	‖Walker, James, Prof., D.Sc. (Edin.), Ph.D. (Leipzig), F.R.S., University College, and 8, Windsor-terrace, Dundee
1890			Walker, James Samuel Hourston, M.B., C.M., (Edin.), D.P.H. (Cantab.), Clinical Research Association, 1, Southwark-street, S.E.
1897	Trans.		Walker, James Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1865	Trans.		‖Walker, John Francis, M.A. (Cantab.), F.I.C., 45, Bootham, York ; and Sidney Sussex College, Cambridge
1888			Walker, John Thom Ainslie, 64, Cannon-street, E.C.
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey, Manchester
1898			Walker, Samuel, M.A. and D.Sc. (Edin.), 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1903			Walker-Pole, Miles, 71, De Korte-street, Braamfontein, Johannesburg, South Africa
1905			Wall, Francis Henry, 7, King's-parade, Church End, Finchley, N.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, A.M. (Harvard), Ph.D. (Columbia), 7, Franklin-place, Morristown, N.J., U.S.A.
1904			Walling, Léon Edward, 43, Union-road, Rotherhithe, S.E.
1902			‖Wallis, Thomas Edward, B.Sc. (Lond.), A.I.C., 96, Stephens-road, Tunbridge Wells, Kent
1883			‖Walmsley, Robert Mullineux, D.Sc. (Lond.), Northampton Institute, St. John Street-road, Clerkenwell, E.C., and 23, Hilldrop-road, Camden-road, N.
1905			Walpole, George Stanley, B.Sc. (Melbourne), Lister Institute of Preventive Medicine, Chelsea-gardens, S.W.
1888			Walrond, Edward Dalrymple, B.A. (Cantab.), North Eastern Counties School, Barnard Castle, Durham
1903			Walsh, Thomas Crosbie, Casilla 614, Antofagasta, Chile, South America

Date of Election.			
1899			Walton, Robert Hawks, Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884			‖Walton, Thomas Utrick, B.Sc. (Glas.), F.I.C., Colonial Sugar Refining Co., Sydney, N.S.W.
1905			Want, William Phillip, 11, Pearfield-road, Forest Hill, S.E.
1864			Ward, George, F.I.C., Buckingham-terrace, Headingley, Leeds
1895			Ward, George John, Hallam Fields, Ilkeston
1891			Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875			Wardle, Sir Thomas, Leek, Staffs.
1863	Trans.	C. 1874-6 78-82. V.P. 89-93.	‖Warington, Robert, Prof., M.A. (Oxon.), F.R.S., High Bank, Harpenden, Herts.
1871			Warner, George Joseph, Halton Villa, Widnes
1906			Warren, Richard Alfred, Belle Vue, Hallow-road, Worcester
1888			Warrick, Frederic Walmsley, 6, Nile-street, City-road, N.
1895			Warrington, Thomas Cotterill, M.A. (Oxon.), 29, Stockwell-street, Leek, Staffs.
1906			Wastenays, Hardolph, Board of Waterworks, Brisbane, Queensland, Australia
1882			Waterfall, Charles James, F.I.C., 4, Queen-square, Bristol
1901			‖Waterhouse, James, Major-General, I.S.C., Hurstmead, High-street, Eltham, Kent
1894			Waterhouse, Robert, 8, Severn-road, Sheffield
1893			Watson, Alexander Forbes, B.Sc. (Edin.), F.I.C., Laboratory, Watling-street, Dublin
1885			Watson, Charles, c/o Messrs. Josiah Hardman, Ltd., Aston Church-road, Birmingham
1904	Trans.		Watson, Edwin Roy, B.A. (Cantab.), B.Sc. (Lond.), Civil Engineering College, Sibpur, Calcutta, India
1887			‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1899			Watson, Fred Sheasby, B.Sc. (Vict.), Sandgate, Villiers-road, Woodthorpe, Nottingham
1904			Watson, Herbert Wood, B.Sc. (Vict.), c/o H. Hogarth, Esq., Denton Avenue, Gledhow, Leeds
1906			Watson, John Adam, 8, Powis-gardens, Notting Hill, W.
1883			‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1876	Trans.		‖Watson, William Henry, J.P., Croft Hall, Seascale, Cumberland
1877			Watt, Alexander, c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1904			Watt, Francis Langston, A.R.C.S., A.I.C., Russenden, Stanley-street, Epping, near Sydney, N.S.W.
1906			Watt, Henry Edgar, M.Sc. (Dun.), A.I.C., 226, Ladywood-road, Edgbaston, Birmingham

Date of Election.		
1883	Trans.	Watts, Hon. Francis, C.M.G., Hon. D.Sc. (Birm.), F.I.C., Government Laboratory for the Leeward Islands, Antigua, West Indies
1906		Watts, James Neill, P.O., Eikenhof, Johannesburg, South Africa
1872	Trans.	‖Watts, John, M.A. (Oxon.), D.Sc. (Lond.), F.I.C., Merton College, Oxford
1878	Trans.	Watts, John Isaac, Beechfield, Hartford, Cheshire
1888		Way, Edward John, F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal, South Africa
1901		Wayland, William Abraham, 12, Albert-road, St. John's, S.E.
1902		Webb, Arthur James, M.A. (Oxon.), B.Sc., 21, Hammelton-road, Bromley, Kent
1883	Trans.	Webster, Charles Stuart Stanford, F.I.C., Malvern House, Redland, Bristol
1866		Webster, George Watmough, 1, Grange-road, West Kirby, Birkenhead
1877		Webster, William, 50, The Park, Blackheath, S.E.
1906	Trans.	Wechsler, Elkan, Ph.D. (Würzburg), 59, Petherton-road, Canonbury, N.
1904		Weeks, Henry Bridges, F.I.C., The Retreat, Infield-park, Barrow-in-Furness
1904		Weinberg, John, Rosa Sugar Works and Distillery, Rosa United Provinces, India
1905		Weiskopf, Eric H., Dynamite Factory, Modderfontein, Transvaal, South Africa
1903		Weiss, Carl Friederich Richard, M.A., Ph.D., (Basel), 27A, St. Mary-at-hill, E.C.
1898		Weissmüller, Edward Charles, Hill Crest, The Heath, Runcorn
1901		Welch, George Edward, B.Sc. (Lond.), Grammar School, Wakefield
1888		Welch, John Cuthbert, General Superintendent, Alaska Copper Co., Coppermount, Alaska, U.S.A.
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen Newcombe, c/o The Gas and Water Co., Ltd., Colombo, Ceylon
1884	Trans.	Wells, James S. Chester, Ph.D. (Columbia), c/o Silver Fissure Mining Co., Polaris, Beaverhead Co., Montana, U.S.A.
1902		Wells, John William, M.D. and C.M. (Edin.), D.P.H. (Vict.), Springburn, Montague-street, Blackburn
1890		Wells, Sydney Russell, B.Sc. and M.D. (Lond.), M.R.C.S. (Eng.), M.R.C.P. (Lond.), 24, Somerset-street, Portland-place, W.
1903		Welsford, Giles Haddon, Royal Gunpowder Factory, Waltham Abbey, Essex

Date of Election.		
1897		Welsh, John, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 43, Tarvin-road, Chester
1888	Trans.	Werner, Emil Alphonse, F.I.C., 5, Church-avenue, Rathmines, Dublin
1886		‖Wertheimer, Julius, Prof., B.A., B.Sc. (Lond.), F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, Charles Alfred, A.R.C.S., F.I.C., 95, Oakhill-road, East Putney, S.W.
1899		West, George Hardstaff, B.Sc. (Lond.), County School, Pembroke Dock
1902		West, Joseph, Bank House, Fenton, Stoke-on-Trent
1898		Weston, Frank Edwin, 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry Adolph, c/o Messrs. Parke, Davis and Co., P.O. Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence John de, 148, Jerningham-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc. (Lond.), 18, Nevilledale-terrace, Durham
1906		Wheaton, Harold Joseph, 21, Chesterton-road, Cambridge
1902		Wheeler, Edward J., Ph.D., 79, Chapel-street, Albany, N.Y U.S.A.
1905		Wheeler, Ernest, 4, Fairfield-terrace, Higher Openshaw, Manchester
1894		Wheeler, Henry Lord, Ph.D. (Yale), The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest, 40, Gillott-road, Edgbaston, Birmingham
1897		Wheelwright, Edwin Whitfield, B.A. (Oxon.), Ph.D. (Munich), F.I.C., Greenholme, Westfield-road, Acock's-green, near Birmingham
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford, Yorks.
1897		White, Arthur James, 243, Albert-road, Jarrow-on-Tyne
1893		White, Henry Clay, Prof., Ph.D. (Virginia), Hon. D.C.L. (Univ. South), Hon. LL.D. (Illinois), University, Athens, Georgia, U.S.A.
1891		White, Henry, 245, Western-road, Crookes, Sheffield
1899		White, Henry Fox, 52, Royal York-crescent, Clifton, Bristol
1905		White, John Ledger, D.Sc. (Dun.), 73, Cambridge-mansions, Battersea Park, S.W.
1889		‖White, John Tsawoo, M.A. (Calcutta), Pyinmana, Upper Burma, India
1905		White, John William, University College, Gower-street, W.C.
1897		White, Paul Thomas, Horton Field, West Drayton, Middlesex
1902		White, William Carter, Glenholme, Longlands-park-road, Sidcup, Kent

Date of Election.		
1893		White, William Gilchrist, Vicarage View, 133, Tottington-road, Bury, Lancs.
1885		Whitehead, Henry Hammond, Holland House, Spring-grove, Isleworth, W,
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, Philip Lewington, Ivy House, Great Barr, Staffs.
1889		‖Whitehouse, William, Albany House, Bradmore, Wolverhampton
1904	Trans.	Whiteley, Charles Edward, 21, Brudenell-view, Leeds
1886	Proc.	‖Whiteley, Richard Lloyd, F.I.C., 5, Bagnall-street, W. Bromwich
1892		Whiteside, John Lowe, 376, St. Helen's-road, Bolton
1863		‖Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, Christopher Joseph, West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, Ansdell, Lytham
1889		Whittam, Matthew, M.A. (Cantab.), 75, Creffield-road, West Acton, W.
1901		Whittle, James, 30, Bridge-street, Morpeth
1900		Wiechmann, Ferdinand Gerard, Ph.D. (Columbia), P.O. Box 79, Station W., Brooklyn, New York, U.S.A.
1906		Wiffen, Henry John, 17, Albany-road, Manor-park, E.
1889		Wigan, Basil Penwarne, Rhondda Valley Brewery Co., Treherbert, Pontypridd
1905		Wigginton, John Henry Becker, 7, Byfeld-gardens, Barnes, S.W.
1906		Wightman, Charles, 43, Portland-place, W.
1896	Proc.	Wigner, John Harrison, Ph.D. (Heidelberg), Roseneath, Carnoustie, Forfarshire
1896		Wilcox, Alfred James, Rev., 1, Bank-terrace, Glossop
1891		‖Wild, John, B.Sc. (Vict.), A.I.C., Bredbury House, Bredbury, Stockport
1898		‖Wild, William Ernest, B.Sc. (Vict.), Alexander-villas, Talbot-road, Glossop
1898		Wilder, Frederick Louis, Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans	Wilderman, Meyer, Ph.D. (Freiburg), B.Sc. (Oxon.), Davy-Faraday Laboratory, Albemarle-street, W.
1881		Wilkes, John Potter, 54½, Old Broad-street, E.C.
1902	Trans.	Wilkinson, Edward John, 8, Blenheim-terrace, Leeds
1904		Wilkinson, James Alfred, M.A. (Cantab.), Transvaal Technical Institute, P.O. Box 1176, Johannesburg, South Africa
1903		Wilkinson, James Bates, M.D. and C.M. (Edin.), D.P.H. (Vict.), Town Hall, Oldham
1893		Wilkinson, John, Corporation Gas Works, Halifax
1905		Wilkinson, John Wells, M.A. (Wales), 50, Woolwich-road, Belvedere, Kent
1891		Will, Wilhelm, Prof., Ph.D. (Berlin), Colonie Grunewald, Boothstrasse 32, bei Berlin, Germany

Date of Election.		
1904	Proc.	Willcox, William Henry, M.D., B.Sc., M.R.C.P. and L.S.A. (Lond.), D.P.H. (Eng.), F.I.C., St. Mary's Hospital, Paddington, W.
1906		Willett, Herbert William Mills, The Cedars, Chislehurst, Kent
1905		Williams, Alan Herbert, 127, Roseneath-road, Urmston, Lancs.
1862	Trans.	‖Williams, Charles Hanson Greville, F.R.S., Bay Cottage, Smallfields, near Horley, Surrey
1903		Williams, David John, Huntly Lodge, 13, Kirkstall-road, Telford-avenue, Streatham Hill, S.W.
1895		Williams, Evan, Bradford-road Gas Works, Manchester
1905		Williams, Gerard William, P.O. Box 21, Germiston, Transvaal, South Africa
1892		Williams, John, Government Laboratory, British Guiana
1883	Proc.	Williams, Rowland, F.I.C., Hale Cote, Albert-park, Lancaster
1891		Williams, Seward Whiting, c/o Messrs. Seabury and Johnson, East Orange, New Jersey, U.S.A.
1872		‖Williams, Thomas, Chemical Laboratory and Assay Office, 8, Victoria-street, Liverpool
1885	Trans.	‖Williams, Walter Collingwood, B.Sc. (Lond.), F.I.C., 68, Grove-street, Liverpool
1892		Williams, William, County Offices, Westgate-street, Cardiff, and 63, Plymouth-road, Penarth
1899	Proc.	Williams, William Arthur, 36, Woodburn-terrace, Edinburgh
1874	Trans.	‖Williams, William Carleton, B.Sc. (Vict.), F.I.C., Broomgrove, Goring-on-Thames, Reading
1898		Williamson, John Alexander, 66, Onslow-gardens, Muswell Hill, N.
1874	Trans.	‖Williamson, Robert, F.I.C., Low Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Ph.D. (Munich), F.I.C., Faireholme, Esher, Surrey
1898		Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1896		Wills, Edward Chaning, M.A. (Cantab.), East Down House, East Down, Barnstaple
1872		Wills, Joseph Lainson, 133, Midwood-street, Flatbush, Brooklyn, New York, U.S.A.
1906		Willstaetter, Richard, Prof., Ph.D. (Munich), Bergstrasse 25, Zürich V, Switzerland
1903		Wilmore, Albert, Municipal Technical School, Colne, Lancs.
1892	Trans.	Wilsmore, Norman Thomas Mortimer, B.Sc. (Melbourne), 126, Walm-lane, Willesden Green, N.W.
1885		Wilson, Alfred Charles, F.R.S.E., Borough Hall, Stockton-on-Tees
1879		‖Wilson, Charles Joseph, F.I.C., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, M.A. (Glas.), D.Sc., Carbeth, Killearn, Glasgow

Date of Election.		
1901		‖Wilson, Duncan, Broadwater Cross, Tunbridge Wells
1899		Wilson, Frederick Robert Leyland, M.A. (Oxon.), Charterhouse, Godalming
1895		Wilson, Harry, F.I.C., 146, High-street, Southampton
1875		‖Wilson, James, M.A. (Dub.), Barrister-at-Law, 2, Essex-court, Temple ; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, F.I.C., 17, Cardigan-road, Richmond Hill, Surrey
1890		Wilson, James Mitchell, M.D. and C.M. (Glas.), D.P.H. (Cantab.), County Hall, Beverley
1901		Wilson, James Scott, M.D. and C.M. (Glas.), D.P.H. (Cantab.), Bradford-street, Walsall
1895	Proc.	Wilson, John, M.Sc. (Vict.), Battersea Polytechnic, S.W.
1899		Wilson, John, 153, Buckley-street, Foots Cray, Victoria, N.S.W.
1891		Wilson, John Henry, A.I.C., Glenthorn, Northumberland-road, Coventry
1902		Wilson, Lyndon Charles, 31, Castle-gate, Newark-on-Trent
1900	Proc.	Wilson, Leonard Philip, Heathblouse, Wallasey Village, Cheshire
1871		‖Wilson, William John, c/o Dr. W. M. Watts, Shirley, Venner-road, Sydenham, S.E.
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich
1893		Winder, Edward Humphreys, Wetmore, Craven Arms, R.S.O., Salop
1894		Wingate, Hamilton More, B.Sc. (Glas.), 90, Queenswood-road, Forest Hill, S.E.
1895		Wingfield, Thomas Rowland, 5, Bromwich-street, Bolton
1876		Winser, Percy James, F.I.C., Moor House, Biddulph Moor, Congleton
1898	Trans.	Witham, Ernest, B.A., B.Sc. (Lond.), The Grammar School, Rotherham
1876	Trans.	‖Witt, Otto Nikolaus, Geh. Rath Prof., Ph.D., Ebereschenallee 10, Westend bei Berlin, Germany
1906		Wolfe, Ernest Edwin, Kinsale, Co. Cork, Ireland
1896		Wolfenden, John Henry, B.Sc. (Lond.), 13, Pole-lane, Failsworth, Manchester
1902		Womersley, Charles Edward, 7, Tidswell-street, Heckmondwike, S.O., Yorks.
1889		Wood, Charles, Rossemount, Emm-lane, Heaton, Bradford
1860	Trans.	‖Wood, Charles Henry, F.I.C., Erica, Bournemouth-road, Parkstone, R.S.O., Dorset
1902		Wood, Frank Stanley, Chin Chu, Heathcote-street, Newland, Hull
1898	Trans.	Wood, Thomas Barlow, M.A. (Cantab.), Gonville and Caius College, Cambridge

Date of Election.			
1903			‖Wood, William Francis John, B.Sc. (Lond.), Hazelhurst, Doncaster-road, Barnsley
1884	Proc.		Wood, William Henry, B.A. (Oxon.), La Martinière, Calcutta
1900			Woodbridge, Walter Bourne, A.C.G.I., 13, Victoria-road, Shoreham, Sussex
1871	Trans.		Woodcock, Reginald C., F.I.C., The Sanitas Co., Ltd., Locksley-street, Limehouse, E.C.
1904			Woodcock, William Henry, 10, Chesson-road, W. Kensington, W.
1898			Woodhead, Samuel Allinson, B.Sc. (Dun.), F.I.C., Agricultural College, Uckfield, Sussex
1892			‖Woods, Hugh, B.A., M.D. and B.Ch. (Dub.), D.P.H. (Cantab.), 26, Welbeck-street, W.
1888			Woodward, James, B.A., B.Sc. (Lond.), F.I.C., Drummond House, 31, Coventry-road, Ilford, Essex
1889			Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1903			Woolhouse, Sidney Herbert, M.A. and B.Sc. (Dub.), A.R.C.S.I., 2, Durham-road, Lower Edmonton, N.
1889			Woosnam, Richard William, F.I.C., 1, The Chase, Warby Mount, Brentwood, Essex
1903			Worden, Edward Chancey, Clark Thread Co., Newark, New Jersey, U.S.A.
1899			Wormell, Thomas Wilson, B.Sc. (Lond.), 38, Theresa-avenue, Bishopston, Bristol
1884			‖Worrall, Jason Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858			‖Worsley, Philip John, Rodney Lodge, Clifton, Bristol
1906			Wortley, Edward Jocelyn, Rectory, Half-way-tree, Jamaica
1906	Trans.		Wren, Henry, 22, Stapleton-hall-road, Stroud Green, N.
1905			Wren, William James, 271, Park-road, Oldham
1898			Wrench, Charles Arthur, 95A, Southwark-street, S.E.
1903			Wright, Fred., c/o Messrs. Elliott Bros., O'Connell-street, Sydney, N.S.W.
1895			Wright, Harold Edward, c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1900			Wright, Herbert Edwards, M.A. (Cantab.), 63, Balgreen-road, Murrayfield, Edinburgh
1878	Trans.		Wright, Lewis Thompson, 10, Linden-gardens, Bayswater, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		‖Wright, William Thomas, 11, Rundle-road, Sheffield
1864			‖Wrightson, John, Prof., College of Agriculture, Downton, Salisbury
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, William Fitzthomas, Wheatley-street, Coventry
1885	Trans.	C. 1892-6, S. 1898-99, 1903-05, V.-P 1905-	Wynne, William Palmer, Prof., D.Sc. (Lond.), F.R.S., F.I.C., A.R.C.S., The University, and 106, Whitham-road, Sheffield

Date of Election.			
1906			Yates, John William, B.Sc. (Lond.), A.R.C.S., 71, North-street, Hugglescote, near Leicester
1903			Yeomans, Williams Wade, The Clayton Aniline Co., Ltd., Clayton, Manchester
1886	Trans.		Yoshida, Hikorokurō, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred Collett, 17, Vicar's-hill, Lewisham, S.E.
1903			Young, Andrew, M.A. and B.Sc. (Edin.), Geological Department, South African College, and 1, Avenue-terrace, Cape Town, South Africa
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, Francis Samuel, M.A. (Oxon.), F.I.C., The College, Bishop's Stortford
1877			‖Young, Frank Watson, F.R.S.E., H.M. Inspector of Science and Art Schools and Classes, 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D. (Munich), 83, Harvard-court-mansions, Honeybourne-road, West Hampstead, N.W.
1895			Young, Henry Stow, F.I.C., c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 12, Edge-hill, Plumstead, Kent
1877			‖Young, John Rymer, 21, Palmyra-square, Warrington
1874			Young, John, 164, Bath-street, Glasgow
1898			Young, John Henry, B.Sc. (Vict.), c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1887	Trans.		Young, John William, B.A. (Lond.), B.Sc. (Lond.), 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc. (Lond.), F.R.S., F.I.C., Trinity College, Dublin
1902			Young, Thomas Arthur, 11, Hampshire-street, Cheetham, Manchester
1873			‖Young, William Charles, F.I.C., 2, Queen Anne's-grove, Bedford Park, W., and Chemical Laboratory, 19/20, Aldgate, E.C.

NUMBER OF HONORARY AND FOREIGN MEMBERS ... 34

" " FELLOWS 2847

Richard Clay and Sons, Limited,
Bread Street Hill, E.C., and
Bungay, Suffolk.

PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XXIII. Nos. 319—334.
JANUARY—DECEMBER, 1907.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1908.

Richard Clay and Sons, Limited,
Bread Street Hill, E.C., and
Bungay, Suffolk.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR 1907.

£20 to E. C. C. Baly: the ultra-violet absorption spectra of organic compounds (continued).

£10 to A. T. Cameron: the physical constants of the potassium salts of succinic acid and its homologues.

£25 to J. A. Carpenter: experiments with highly purified gases.

£5 to A. E. Dunstan: the application of viscosity to the question of the existence of racemates in the liquid state.

£5 to C. E. Fawsitt: the viscosity of fluid substances (including metals) and the physico-chemical properties of solids in different states (phases) (continued).

£15 to K. Fisher: separation of tetrahydro-*p*-toluic acid into its optically active modifications, and attempt to synthesise sylvestrene.

£15 to W. N. Haworth: preparation of terpenes and the synthesis of fenchone.

£5 to Miss Annie Homer: the products of the action of aluminium chloride on naphthalene.

£10 to T. M. Lowry: studies in dynamic isomerism (continued).

£15 to A. N. Meldrum: conversion of symmetrical hydroxy-*m*-toluic acid into its hexahydro-derivative, and attempt to synthesise a terpene.

£5 to T. S. Moore: the measurement of the true ionisation constants, and of the hydration constants of amines, pseudo-acids, and bases and lactones.

£5 to R. H. Pickard: the relationship between optical activity and chemical constitution.

£1. 14. 1 to F. G. Pope: the relation between colour and constitution in the azomethine series.

£20 to R. Robinson: synthesis of some of the more important oxidation products of brazilin.

£20 to J. L. Simonsen: synthesis of norpinic, pinic, and pinonic acids, and the oxidation products of pinene.

£5 to C. Smith: the constitution of hydroxyazo-compounds.

£10 to A. W. Stewart: the relation between the constitution and dielectric constants of various organic compounds.

£20 to J. J. Sudborough: "Steric Hindrance," polynitro-compounds, and derivatives of cinnamic acid (continued).

£12 to W. B. Tuck: the constitution of the oxyazo-compounds.

£15 to V. H. Veley: hydrolysis of hydrochlorides of bases by means of methyl-orange solution.

£15 to H. Watson: preparation of ketonic acids from methyl *cyclo*-hexanones.

£10 to E. A. Werner: the derivatives of multivalent iodine.

£10 to G. Young: heterocyclic compounds (continued).

Total amount granted during 1907 = £273. 14. 1.

LIST OF FELLOWS ELECTED DURING 1907.

Name.	Proposed.	Elected.
Allan, John Campbell	February 7th, 1907	May 2nd.
Allen, Alfred Frederick	December 20th, 1906.	February 21st.
Bagley, George	December 6th, 1906.	,, ,,
Bailey, Francis James	February 7th, 1907	May 2nd.
Baker, Frank	December 6th, 1906.	February 21st.
Ball, William Robert	February 21st, 1907.	May 2nd.
Banks, Arthur John	June 20th, 1907	December 5th.
Barnett, Edward de Barry	November 7th, 1907.	,, ,,
Bassett, Henry, jun.	December 20th, 1906.	February 21st.
Bell, John Forbes	October 24th, 1907	December 5th.
Benton, Frank Stanley	November 15th, 1906.	February 21st.
Berry, Leslie Hamilton	January 17th, 1907	,, ,,
Buckney, Frank	June 6th, 1907	December 5th.
Caldwell, Kenneth Somerville	March 21st, 1907	May 2nd.
Callan, Thomas	July 4th, 1907	December 5th.
Cameron, Alexander Thomas	February 21st, 1907.	May 2nd.
Cart, John Trevor	November 15th, 1906.	February 21st.
Caton, Frederic William	November 7th, 1907.	December 5th.
Christie, John	December 20th, 1906.	February 21st.
Clough, George William	November 15th, 1906.	,, ,,
Colebourn, William Arthur	May 16th, 1907	June 20th.
Cook, Taylor	December 6th, 1906.	February 21st.
Copping, Hugh Hague	April 18th, 1907	June 20th.
Cowap, Matthewman Dalton	,, ,, ,,	,, ,,
Crisp, George Hugh	November 7th, 1907.	December 5th.
Croghan, Edward Henry	November 21st, 1907.	,, ,,
Cunningham, John Arthur	March 7th, 1907	May 2nd.
Dall, Colin Ernest	December 6th, 1906.	February 21st.
Davidson, Francis	December 20th, 1906.	,, ,,
Day, Edward Joseph	October 24th, 1907	December 5th.
Dealy, Thomas Kirkman	April 18th, 1907	May 2nd.
Denham, William Smith	December 20th, 1906.	February 21st.
Dikshit, Mohan Nath Kedarnath	January 17th, 1907	,, ,,
Duckworth, Samuel	March 7th, 1907	May 2nd.
Dupré, Frederick Harold	October 24th, 1907	December 5th.
Dupré, Percy Vivian	,, ,, ,,	,, ,,
Dutton, Francis Bridger	,, ,, ,,	,, ,,
Eastaugh, Frederick Alldis	December 6th, 1906.	February 21st.
Elias, Owen Aubrey	May 2nd, 1907	June 20th.
Farmer, John Edwin	January 17th, 1907	February 21st.
Fawcitt, Claude Scott	November 7th, 1907.	December 5th.

Name.	Proposed.	Elected.
Fischer, Eugen	April 18th, 1907.	June 20th.
Foreman, Charles Thomas	November 21st, 1907.	December 5th.
Fowles, George	December 20th, 1906.	February 21st.
Fox, John Jacob	March 21st, 1907	May 2nd.
Foxell, Edward William Lanchester	December 6th, 1906..	February 21st.
Fryer, Percival John	January 17th, 1907...	,, ,,
Gibson, Charles Stanley	February 7th, 1907 ..	May 2nd.
Gibson, William Howieson	December 6th, 1906...	February 21st.
Gledhill, Walter George	April 18th, 1907	June 20th.
Godden, William	December 20th, 1906.	February 21st.
Green, William Heber	January 17th, 1907...	,, ,,
Greenough, Thomas Rigby	October 24th, 1907 ...	December 5th.
Gregory, Joshua Craven	February 7th, 1907...	May 2nd.
Grieb, Christopher Maurice Walter	December 6th, 1906..	February 21st.
Hall, Joseph Henry	March 21st, 1907	May 2nd.
Harrington, Arthur George	March 7th, 1907	,, ,,
Harvey, Thomas Featherstone	March 21st, 1907	,, ,,
Hay, William	June 6th, 1907	December 5th.
Higham, Richard	January 17th, 1907 ..	February 21st.
Hooton, William Marrs	December 6th, 1906..	,, ,,
Hope, Geoffrey Dodleston	February 21st, 1907 .	May 2nd.
Houghton, Edward	March 21st, 1907	,, ,,
Hoyten, William James	January 17th, 1907 ..	February 21st.
Hubbard, Hon. Raymond Egerton	February 21st, 1907..	May 2nd.
Hughes, Francis Townshend Cunynghame	January 17th, 1907 ..	February 21st.
Humphries, Herbert Brooke Perren	February 21st, 1907 .	May 2nd.
Hussey, Arthur Vivian	December 6th, 1906 .	February 21st.
Hutchinson, William Doge	October 24th, 1907 ...	December 5th.
Ingham, Harry	,, ,, ,,	,, ,,
Jackson, Ernest Wilfrid	December 6, 1906	February 21st.
Jackson Victor George	November 15th, 1906.	,, ,,
Jennings, John Atkinson	April 18th, 1907	June 20th.
Jennings, Sidney James	January 17th, 1907..	February 21st.
Jensen, Charles William Lamb	May 16th, 1907	June 20th.
Jones, Benjamin Owen	July 4th, 1907	December 5th.
Kaye, John	June 20th, 1907	,, ,,
King, Albert Theodore	December 6th, 1906...	February 21st.
Lewis, Carl	March 21st, 1907	May 2nd.
Lloyd, Percival George	April 18th, 1907.	June 20th.
Lunan, George	January 17th, 1907 .	February 21st.
McConnan, James	February 21st, 1907 .	May 2nd.
Marsden, Herbert	October 24th, 1907 ...	December 5th.
Marshall, Hubert Frederick Sankey	,, ,, ,,	,, ,,
Martin, Gerald Hargrave	,, ,, ,,	,, ,,
Martin, Joseph	December 6th, 1906 .	February 21st.
Matthews, Charles Pask	December 20th, 1906.	,, ,,
Mitchell, Herbert Victor	March 21st, 1907	May 2nd.

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Moore, John Edward Langford	October 24th, 1907	December 5th.
Mummery, Charles Samuel	,, ,, ,,	,, ,,
Murgatroyd, Louis	November 15th, 1906.	February 21st.
Nuttall, Walter Harold	May 2nd, 1907	June 20th.
Oberländer, Otto	December 6th, 1906	February 21st.
Pochin, Harold	April 18th, 1907	June 20th.
Remfry, Frederic George Percy	December 6th, 1906	February 21st
Rhodes, Percy Joseph	February 21st, 1907	May 2nd.
Rixon, Frederic William	March 7th, 1907	,, ,,
Robertson, Robert	November 15th, 1906	February 21st.
Robinson, John	February 7th, 1907	May 2nd.
Sahni, Ruchi Ram	May 16th, 1907	June 20th.
Salway, Arthur Henry	November 15th, 1906	February 21st.
Saunders, George Joseph	June 6th, 1907	December 5th.
Schlienger, Charles	December 20th, 1906.	February 21st.
Schober, William Bush	June 20th, 1907	December 5th.
Sewell, William George	December 20th, 1906.	February 21st.
Shepheard, Frederick George	,, ,, ,,	,, ,,
Smith, Robert Harry	July 4th, 1907	December 5th.
Smith, Robert Low	November 15th, 1906.	February 21st.
Smith, Sidney William	February 21st, 1907	May 2nd.
Stobie, Harold Ramsay	October 24th, 1907	December 5th.
Sturrock, George Colleymore	March 21st, 1907	May 2nd.
Sutcliffe, Sam Mortimer	,, ,, ,,	,, ,,
Tarr, Nicholas	February 21st, 1907	,, ,,
Tebb, William Scott	,, ,, ,,	,, ,,
Templeton, William Saudilands	November 15th, 1906.	February 21st.
Thomas, Frederick	October 24th, 1907	December 5th.
Thomas, Richard Noel Garrod	December 6th, 1906	February 21st.
Timpany, Harold Munkman	October 24th, 1907	December 5th.
Tinkler, Charles Kenneth	April 18th, 1907	June 20th.
Toch, Maximilian	November 15th, 1906	February 21st.
Tonner, William Griffiths	March 7th, 1907	May 2nd.
Twiney, William George	January 17th, 1907	February 21st.
Warner, Charles Horne	May 16th, 1907	June 20th.
Watkins, Charles Rowlatt	January 17th, 1907	February 21st.
Watson, George Arthur	October 24th, 1907	December 5th.
Wechsler, Marcus	June 20th, 1907	,, ,,
Wheeler, Edward	October 24th, 1907	,, ,,
Whymper, Robert	,, ,, ,,	,, ,,
Wight, Robert Burt	December 6th, 1906	February 21st.
Williams, Percy	October 24th, 1907	December 5th.
Williams, William Henry	January 17th, 1907	February 21st.
Willott, David	June 6th, 1907	December 5th.
Wilson, William John	October 24th, 1907	,, ,,
Wolff, Mark Arthur	December 6th, 1906	February 21st.
Wootton, Hubert Arthur	June 6th, 1907	December 5th.
Young, Walter Ormston	May 2nd, 1907	June 20th.
Zortman, Israel Hyman	,, ,, ,,	,, ,,

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Name.	Elected.	Died.
Aitken, Andrew Charles	February 7th. 1901	October 12th, 1907.
Andrews, Thomas	March 7th, 1870	June 19th, 1907.
Austen, Peter Townsend	February 17th, 1877	December 30th, 1907.
*Berthelot, Marcellin	March 1st, 1860	March 18th, 1907.
Bottle, Alexander	March 6th, 1873	October 4th, 1907.
Bowen, William	February 18th, 1903	January 29th, 1907.
Chapman, Edward	January 16th, 1868	July 25th, 1906.
Clark, John	December 7th, 1876	July 9th, 1907.
Dupré, August	January 19th, 1860	July 15th, 1907.
Gale, James	April 19th, 1866	February 12th, 1907.
Gamble, Sir David	March 17th, 1851	February 4th, 1907.
Hall, Samuel	June 1st, 1876	December 9th, 1907.
Harcourt, Leveson Francis Vernon	April 16th, 1863	September 14th, 1907.
Harrington, Bernard J.	June 17th, 1897	November 29th, 1907.
Ince, Joseph	February 7th, 1867	December 5th, 1907.
Keeling, Frank	December 20th, 1883	August 1st, 1906.
*Mendeléeff, Dmitri Ivanovitsch	February 1st, 1883	February 2nd, 1907.
*Menschutkin, Nicolai	January 20th, 1898	February 5th, 1907.
*Moissan, Henri	January 20th, 1898	February 20th, 1907.
O'Sullivan, Cornelius	April 20th, 1876	January 8th, 1907.
Page, Frederick James Montague	December 21st, 1871	August 16th, 1907.
Palmer, Arthur Charles	July 5th, 1906	December 5th, 1907.
Parfitt, Samuel	February 15th, 1906	November 18th, 1907.
Perkin, Sir William Henry	December 15th, 1856	July 14th, 1907.
Perkins, Hugh Donald	December 7th, 1905	March 19th, 1907.
Polkinghorne, Bennett Corcyra	December 7th, 1899	December 29th, 1907.
Pritchard, William	February 17th, 1870	November 20th, 1906.
Swann, Robert Reed	May 4th, 1905	November 19th, 1907.
Walker, John Francis	February 2nd, 1865	May 23rd, 1907.
Warington, Robert	March 19th, 1863	March 20th, 1907.
Wright, Herbert Edwards	December 6th, 1900	February 2nd, 1907.

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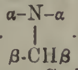
144. The condensation of aldehydes with mixtures of α-naphthol and α-naphthylamine: synthesis of 7-aryl-$\begin{matrix}\alpha\text{–N–}\alpha\\ \vert\\ \beta\text{-CH}\beta\end{matrix}$-dinaphthacridines. By Alfred Senier and Percy Corlett Austin ...	185	1233
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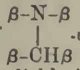
254. Attempted synthesis of  $\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \beta\text{–CH}\beta\end{array}$ -dinaphthacridine; condensation of methylene dichloride and 1-substituted-2-naphthylamines. By Alfred Senier and Percy Corlett Austin	300	63*
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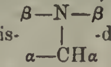
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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 319.

Thursday, January 17th, 1907, at 8.30 p.m., Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. P. S. Arup, W. C. Ball, and J. Hamer were formally admitted Fellows of the Society.

The President announced the decision of the Council that during the remainder of the present Session the Library shall be kept open for the use of Fellows every Thursday from 10 a.m. until 9 p.m., except on those evenings on which the Society meets when it will remain open until 10.30 p.m.

Certificates were read for the first time in favour of Messrs. :

Leslie Hamilton Berry, B.Sc., Penshurst, Croham Park Avenue, S. Croydon.
Mohan Nath Kedarnath Dikshit, 21, Burlington Road, Bayswater, W.
John Edwin Farmer, Blelsoe, New Road, Mitcham Junction.
Percival John Fryer, 27, Minster Road, Cricklewood, N.W.
William Heber Green, D.Sc., The University, Melbourne.
Richard Higham, 133, Mauldeth Road, Withington, Manchester.
William James Hoyten, M.R.C.S., F.R.C.P., 37, Ravelstoke Road, Wimbledon Park, S.W.

Francis Townshend Cunynghame Hughes, Major, Royal Mint, Calcutta, India.
Sidney James Jennings, B.Sc., 367, Queen's Road, New Cross, S.E.
George Lunan, 50, Garscube Terrace, Murrayfield, Edinburgh.
William George Twiney, B.Sc., St. Joseph's College, Colombo, Ceylon.
Charles Rowlatt Watkins, B.A., Aldenham School, Elstree, Herts.
William Henry Williams, Government Education Dept., Hong Kong.

The Council has ordered the following letter and report to be printed in the Journal and Proceedings of the Society:

GOVERNMENT LABORATORY,
CLEMENT'S INN PASSAGE,
STRAND, LONDON, W.C.
15*th November*, 1906.

GENTLEMEN,

I have the honour to forward to you, for presentation to the Council of the Chemical Society, the Report of the International Committee on Atomic Weights, 1907, to which I have affixed, as desired by them, the names of Professors Moissan and Ostwald.

The Committee, for reasons stated in the Report, have suggested new values for the atomic weights of bismuth, nitrogen, tantalum, and terbium, and they are further of opinion that alterations are needed in the atomic weights of silver and chlorine, but before recommending any change as regards these elements they consider it expedient to wait for fuller information of the results of determinations known to be in progress. The new values for silver and chlorine will, of course, have an influence upon a large number of atomic weights.

I am, Gentlemen,
Your obedient Servant,
T. E. THORPE.

The Hon Secretaries,
The Chemical Society,
Burlington House,
London, W.

Report of the International Committee on Atomic Weights, 1907.

Since the preparation of our last report, for 1906, a number of important memoirs upon atomic weights have appeared. The results obtained may be briefly summarised as follows:

Bismuth.—Work done at Erlangen under the direction of Gutbier (*Zeit. Elektrochem.*, 1905, 11, 831) has been published in the form of three doctoral dissertations (L. Birckenbach, 1905; H. Mehler, 1905; R. L. Janssen, 1906). Birckenbach, by synthesis of the oxide from the metal, found, in mean, Bi = 208·05. A series of reductions of the oxide gave Bi = 208·08. Mehler determined the ratio $BiBr_3 : AgBr$, and found Bi = 208·05. By synthesis of the sulphate from the metal, Janssen obtained the value Bi = 208·074. These determinations are concordant, and also agree with the earlier measurements by Schneider and Löwe and with a series by Marignac. The atomic weight of bismuth, therefore, is to be taken as 208·0 in round numbers, and the value 208·5, as hitherto given in our table, is too high.

Bromine.—Baxter's (*J. Amer. Chem. Soc.*, 1906, **28**, 1322) determinations of this constant are based upon the antecedent values Ag = 107·93 and Cl = 35·473. Eighteen syntheses of silver bromide gave, in mean, Br = 79·953. Thirteen experiments upon the conversion of AgBr into AgCl gave Br = 79·952.

Cadmium.—The memoir by Baxter, Hines, and Frevert (*ibid.*, 1906, **28**, 770) is a continuation of the research which was noted last year. Four ratios were measured with the following results, when Ag = 107·93:

$CdBr_2 : 2Ag.$ Cd = 112·470.
$CdBr_2 : 2AgBr.$ Cd = 112·464.
$CdCl_2 : 2Ag.$ Cd = 112·471.
$CdCl_2 : 2AgCl.$ Cd = 112·470.

Copper.—A series of analyses and syntheses of copper oxide by Murmann (*Monatsh.*, 1906, **27**, 351) gave the value Cu = 63·53. The data are not concordant, and the determinations are not entitled to much weight.

Iodine.—Gallo (*Gazzetta*, 1906, **36**, 116) has determined the atomic weight of iodine electrolytically, comparing the iodine liberated by a current with the silver deposited. His values range from 126·82 to 126·98, or, in mean, 126·89 when Ag = 107·93. This result is more nearly in accord with the determination by Stas than with the later measurements.

Nitrogen.—Gray's (*Trans.*, 1905, **87**, 1601) work upon the atomic weight of this element, noticed in our report for 1906, has since been published in full. His mean results are as follows: from the density of nitric oxide, N = 14·006; from the analysis of nitric oxide, N = 14·010; from the density of nitrogen, N = 14·008. The mean of all the determinations is N = 14·0085, or very nearly 14·01. This agrees closely with the earlier measurements by Guye, Rayleigh, and Leduc, and leaves no reasonable doubt but that the new value should replace the 14·04 as given in our annual table. In a later paper (*Trans.*, 1906, **89**, 1173) Gray has gathered corroborative evidence from various sources, and has discussed Stas's ratios in order to discover their possible errors. Other discussions of similar purport are by Guye * and Scott (*Chem. News*, 1906, **93**, 20), but they are not final. Experimental evidence alone can reveal the cause of discrepancy between the new figure and the old.

Palladium.—Amberg (*Annalen*, 1905, **341**, 235) has redetermined the atomic weight of palladium by analysis of palladosoammine chloride, $PdN_2H_6Cl_2$. The value obtained is Pd = 106·688, or 106·7 nearly. Five other analyses of the same salt, by Krell (*Inaug. Dissertation*, Erlangen, 1906), gave a mean of Pd = 106·694. Recalculated with Richards's value for Cl, and rejecting one experiment as defective, Krell concludes that Pd = 106·78, but this again would be lowered by the adoption of the newer value for N. Any change in this constant may well be deferred until the antecedent atomic weights are more definitely known.

Silver.—In an attempt to determine the source of error in Stas's figures for nitrogen, Guye and Ter Gazarian † examined the fundamental potassium chlorate ratio. They found that potassium chlorate crystallises with a small quantity of chloride as an impurity, the amount being nearly constant and about 2·7 parts in ten thousand. Applying this correction to Stas's ratios, his value for silver is lowered from 107·93 to 107·89. A re-discussion of ten fundamental ratios gave figures for silver ranging from 107·871 to 107·908, or 107·89 in mean. If this conclusion is sustained, the Stas's ratios for silver nitrate will give a value for nitrogen in harmony with the figures obtained by Guye and Gray.

Tantalum.—Hinrichsen and Sahlbom (*Ber.*, 1906, **39**, 2600) have determined the atomic weight of tantalum by conversion of the metal into the pentoxide. Five such syntheses gave Ta = 180·59 to 181·77, or 181·0 in mean. This value should replace the old determination by Marignac as given in our previous tables.

The Rare Earths.—On the metals of this group a notable amount of work has been published during 1906. From five determinations of water in terbium sulphate, Urbain (*Compt. rend.*, 1906, **142**, 957) deduces the value Tb = 159·22; and this should supplant the older, questionable data. In another paper (*ibid.*, 1906, **142**, 785) Urbain gives an atomic weight of 163·49 to dysprosium, but without details or weighings.

By a volumetric method, Feit and Przibylla (*Zeit. anorg. Chem.*, 1906,

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* *Ber.*, 1906, **39**, 1470. For Guye and Bogdan's complete memoir upon nitrous oxide, see *J. Chim. phys.*, 1905, **3**, 537.

† *Compt. rend.*, 1906, **143**, 411. See also *J. Chim. phys.*, 1906, **4**, 174, for a paper by Guye on the need of a general recalculation of atomic weights.

50, 249) have determined the amount of sulphuric acid required to neutralise several of the oxides in this group, and have in that way obtained new estimates of the corresponding atomic weights. The final results, reduced to a vacuum standard, are as follows:

Lanthanum	139·17	Europium	152·66
Praseodymium	140·62	Gadolinium	157·38
Neodymium	144·52	Ytterbium	173·52
Samarium	150·47	Yttrium	89·40

In Abegg's *Handbuch der anorganische Chemie*, Brauner has given full summaries of all atomic weight determinations. With these summaries, in connexion with the rare earth metals (in Bd. 3, Abth. 1, pp. 263, 276, 284, 304, 318, 335), he has cited some hitherto unpublished determinations of his own. His results are:

Praseodymium	140·97	Gadolinium	155·78
Neodymium	143·89	Erbium	167·14
Samarium	150·71	Ytterbium	173·08

Among these figures that for Gd is admittedly too low, and that for Sa is vitiated by the presence of europium in the material studied.

From the evidence presented in this report, and in preceding years, we now feel justified in recommending the following changes in the table:

Nitrogen, from 14·04 to 14·01.
Bismuth, ,, 208·5 ,, 208·0.
Tantalum, ,, 183·0 ,, 181·0.
Terbium, ,, 160·0 ,, 159·2.

Other changes which seem to be needed because of alterations in the atomic weights of silver and chlorine cannot yet be made with safety. The atomic weight of silver, as deduced from Stas's data, is probably too high, but by an unknown amount, and that will affect the entire table. If we assume, with Guye, that Ag = 107·89, with the proportional changes in Cl and Br, the atomic weight of barium, as determined by Richards, will be reduced by 0·05. Such a change, which is probably extreme, does not affect the utility of the accepted atomic weights at all seriously, and no important interest will suffer if we delay the suggested alterations until our knowledge of the corrections to be applied is more exact. Guye's conclusions, although strongly supported, are not final, and they should be neither accepted nor rejected except upon the basis of much more complete evidence than we now possess. The atomic weight of chlorine, as given in our last report, is certainly too low, but it depends in part upon the undetermined change to be applied to silver. For that reason, as well as for the reason that a change in chlorine affects many other values, we prefer to leave the figures as they are and to wait for fuller information. That information will doubtless be supplied by researches now known to be in progress, and the corrections which they will furnish ought not to be delayed very long.

One addition to the table seems to be legitimate. Europium, with an approximate atomic weight of 152, appears to be a definite element, as shown by the investigations of Demarçay, Urbain and Lacombe, Eberhard, and Feit and Przibylla. Its existence is recognised in Abegg's Handbuch, and its claims to a place in the table are certainly as great as those of erbium, thulium, or terbium. As for dysprosium, its admission to the table may well be delayed until a better determination of its atomic weight shall have been made.

In conclusion, we urge upon all chemists who are engaged in the determination of atomic weights to send copies of their publications to all the members of this committee in order that their work may be promptly recognised and not overlooked. Data published in standard journals are of course easily found, but publications of local societies and doctoral dissertations might readily escape our notice.

Professor Seubert, an original member of this committee, has resigned. Professor Ostwald has been designated as his successor.*

The table offered for 1907 is appended hereto.

F. W. Clarke,
Henri Moissan,
Wilhelm Ostwald,
T. E. Thorpe.

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[*] See *Ber.*, 1906, **39**, 2176, for the formal announcement of this change.

1907.

International Atomic Weights.

Aluminium	Al	27·1	Neodymium	Nd	143·6
Antimony	Sb	120·2	Neon	Ne	20
Argon	A	39·9	Nickel	Ni	58·7
Arsenic	As	75·0	Nitrogen	N	14·01
Barium	Ba	137·4	Osmium	Os	191
Bismuth	Bi	208·0	Oxygen	O	16·00
Boron	B	11·0	Palladium	Pd	106·5
Bromine	Br	79·96	Phosphorus	P	31·0
Cadmium	Cd	112·4	Platinum	Pt	194·8
Cæsium	Cs	132·9	Potassium	K	39·15
Calcium	Ca	40·1	Praseodymium	Pr	140·5
Carbon	C	12·00	Radium	Rd	225
Cerium	Ce	140·25	Rhodium	Rh	103·0
Chlorine	Cl	35·45	Rubidium	Rb	85·5
Chromium	Cr	52·1	Ruthenium	Ru	101·7
Cobalt	Co	59·0	Samarium	Sa	150·3
Columbium	Cb	94	Scandium	Sc	44·1
Copper	Cu	63·6	Selenium	Se	79·2
Erbium	Er	166	Silicon	Si	28·4
Europium	Eu	152	Silver	Ag	107·93
Fluorine	F	19·0	Sodium	Na	23·05
Gadolinium	Gd	156	Strontium	Sr	87·6
Gallium	Ga	70	Sulphur	S	32·06
Germanium	Ge	72·5	Tantalum	Ta	181
Glucinum	Gl	9·1	Tellurium	Te	127·6
Gold	Au	197·2	Terbium	Tb	159·2
Helium	He	4·0	Thallium	Tl	204·1
Hydrogen	H	1·008	Thorium	Th	232·5
Indium	In	1·15	Thulium	Tm	171
Iodine	I	126·97	Tin	Sn	119·0
Iridium	Ir	193·0	Titanium	Ti	48·1
Iron	Fe	55·9	Tungsten	W	184
Krypton	Kr	81·8	Uranium	U	238·5
Lanthanum	La	138·9	Vanadium	V	51·2
Lead	Pb	206·9	Xenon	Xe	128
Lithium	Li	7·03	Ytterbium	Yb	173·0
Magnesium	Mg	24·36	Yttrium	Yt	89·0
Manganese	Mn	55·0	Zinc	Zn	65·4
Mercury	Hg	200·0	Zirconium	Zr	90·6
Molybdenum	Mo	96·0			

Of the following papers, those marked * were read :

*1. "The relation between absorption spectra and optical rotatory power. Part I. The effect of unsaturation and stereoisomerism." By Alfred Walter Stewart.

The author has examined the absorption spectra of certain saturated and unsaturated acids, and compared the results with the rotatory power of their amyl esters. The results show that a close relation exists between the general absorption power of compounds and their molecular rotation. The substance having the greater general absorption has also the greater molecular rotation. The case of the amyl esters of hydrocinnamic, cinnamic, and phenylpropiolic acids, which seems anomalous at first sight, agrees with this. An examination of the spectra of some stereoisomeric acids of the ethylene series showed that the rule holds in their case also. Experiments are in progress in other branches of the subject, for example, active and inactive isomerides, birotation, the influence of the solvent on the rotatory power, &c.

DISCUSSION.

Dr. McKENZIE pointed out that the values for the molecular rotations of the amyl esters of hydrocinnamic, cinnamic, and phenylpropiolic acid respectively, determined by Walden and quoted by the author, were obviously incorrect, since the amyl alcohol used by Walden in 1896 was a mixture.

Since it was now possible to separate the optically active constituent of fusel oil in a pure state by means of 3-nitrophthalic acid (*Ber.*, 1901, **34**, 485), he asked whether the author had prepared the pure esters in question and determined their rotations.

Mr. STEWART explained that owing to the complexity of the amyl spectrum it had been found best to examine the spectra of the acids and not those of the amyl esters. The cause of the change in rotation evidently is to be sought in the acidic part of the ester molecule. The results obtained by Sir W. H. Perkin in the case of the magnetic rotation of saturated and unsaturated acids agree with those observed in the case of optically active esters of the saturated and unsaturated series.

*2. "Organic derivatives of silicon. Part II. The synthesis of *dl*-benzylethylpropylsilicol, its sulphonation, and the resolution of the sulphonic derivative into optically active components." By Frederic Stanley Kipping.

dl-*Benzylethylpropylsilicol*, EtPrBzSi·OH, has been synthesised by the following series of reactions (compare *Proc.*, 1904, **20**, 15):

$SiCl_4 + MgEtBr = SiEtCl_3 + MgClBr.$

$SiEtCl_3 + MgPhBr = SiEtPhCl_2 + MgClBr.$

$SiEtPhCl_2 + MgPrBr = SiEtPhPrCl + MgClBr.$

$SiEtPhPrCl + MgBzCl = SiEtPhPrBz + MgCl_2.$

$SiEtPhPrBz + H_2O(+H_2SO_4) = SiEtPrBz{\cdot}OH + C_6H_6(+H_2SO_4).$

The silicol thus initially produced yields, with sulphuric acid, a mixture of sulphonic acids of which one has been isolated in the form of its ammonium salt.

This acid is probably a derivative of the corresponding oxide, having the constitution $SO_3H{\cdot}C_6H_4{\cdot}CH_2{\cdot}SiEtPr{\cdot}O{\cdot}PrEtSi{\cdot}CH_2{\cdot}C_6H_4{\cdot}SO_3H$; it is the externally compensated compound, and although many of its salts with optically active bases crystallise unchanged, the *d*-methylhydrindamine salt can be resolved by crystallising fractionally from aqueous methyl alcohol.

The *dBdA*-salt is the more sparingly soluble and melts at about 205°; the impure *dBlA*-salt from the most soluble fractions melts at about 135°.

The *lBlA*-salt has been prepared by resolving the acid with *l*-methylhydrindamine.

The two optically active acids have very low specific rotations ($[\alpha]_D \pm 4°$ roughly), but there is ample evidence of their enantiomorphous relationship.

Discussion.

Dr. Lewkowitsch, referring to the statement that different melting points were obtained with one and the same substance, asked whether this phenomenon was accompanied by the appearance of different colours, such as Jaeger had observed in the case of the liquid anisotropic phases of the esters of cholesterol and phytosterol at their different melting points.

Prof. Kipping stated that the appearance of such colours had not been observed by him.

*3. "The association of phenols in the liquid condition." By John Theodore Hewitt and Thomas Field Winmill.

The authors have determined the surface energy of several liquids, and find that the association of phenols is diminished or entirely inhibited by the presence of ortho-substituents. Comparison with meta- and para-isomerides has clearly shown that the effect is due more to the position than to the nature of the substituent group.

The effect of steric hindrance is also seen with the aromatic alcohols. Monophenylcarbinol (benzyl alcohol) is markedly associated at the ordinary temperature; the molecular weights of fused di- and triphenylcarbinol are, however, normal.

Discussion.

Dr. Hewitt, replying to the remarks of the President, said he supposed that probably they (the authors) had not encountered the best conditions for converting *o*-aminophenol into *o*-bromophenol. Respecting Mr. Baly's contention that any hindrance to association was structural rather than sterical, it was at least remarkable that the groups of larger molecular volume had a more marked effect than those, such as methyl and chlorine, whose molecular volume was smaller.

*4. "A new mercuric oxychloride." By John Theodore Hewitt.

On allowing solutions of sodium hydroxide and mercuric chloride in sodium chloride to diffuse into one another, a layer of sodium chloride solution of intermediate density being interposed, very dark red crystals having the formula $Hg_6O_5Cl_2$ are deposited. These were at first considered to be red mercuric oxide or mercuric hydroxide, since on solution in hot dilute nitric acid and addition of silver nitrate solution no precipitate was obtained.

It has now been found that if a silver chloride precipitate is suspended in dilute nitric acid and mercuric oxide added, not only is the latter dissolved but also the silver chloride.

In the estimation of chlorine in the oxychloride the latter was dissolved in warm dilute sulphuric acid, the mercury precipitated with sodium hyposulphite, and after oxidation of the excess of this reagent with dilute nitric acid, the chlorine was estimated in the usual way as silver chloride.

Discussion.

Dr. Hewitt was afraid he had not made the fact quite clear, that when silver chloride is dissolved in dilute nitric acid by addition of mercuric oxide the result is not to be attributed to the formation of a complex silver ion, but to the employment of the chlorine in forming complex ions with the mercury. The solubility of silver salts in albumenoid solutions mentioned by Dr. Divers was hardly of a similar nature, in the latter case solution depended rather on colloidal suspension.

*5. "Preparation of chromyl dichloride." By Herbert Drake Law and Frederick Mollwo Perkin.

The authors find that the best method for preparing chromyl dichloride is to dissolve chromic acid in rather more than the equivalent quantity of concentrated aqueous hydrochloric acid and to add to this solution concentrated sulphuric acid in small quantities at a time, the mixture being cooled between each addition. After standing for about twenty minutes in a tap funnel the heavy under layer of chromyl dichloride is drawn off. It can be purified by aspirating dry air through it and subsequent distillation. The yield is almost theoretical.

*6. "Oxidation of hydrocarbons of the benzene series." By Herbert Drake Law and Frederick Mollwo Perkin.

The authors have examined the products of oxidation of aromatic hydrocarbons by lead peroxide and manganese peroxide in acid solution, by chromyl dichloride and by persulphates in acid solution in presence of silver salts.

The hydrocarbons investigated were toluene, the three xylenes, mesitylene, ψ-cumene, and cymene. In all cases varying yields of the monoaldehydes were obtained.

Toluene gave with lead peroxide 24 per cent. of benzaldehyde, with manganese peroxide 5 per cent., with chromyl dichloride 44 per cent., and with persulphates 78 per cent. In the remaining cases, as a rule, the yield with chromyl dichloride was better than with the other oxidising agents, that obtained with persulphates being second. In general, lead peroxide gave a larger quantity of aldehyde than did manganese peroxide.

7. "The constitution of silver nitrite; a correction." By Edward Divers.

In the opening paragraph of a paper which has just appeared (*Trans.*, 1906, **89**, 1900), Rây and Neogi state that the present writer is inclined to accept as fairly conclusive the evidence which they have adduced in favour of the oxylic constitution of silver nitrite.

In his note in the Proceedings (1905, **21**, 281), to which they make reference, no opinion at all is expressed as to the constitution of silver nitrite. The authors must have made the statement under some misapprehension of the writer's words, which he cannot account for.

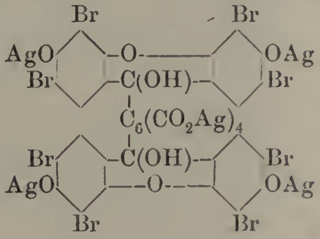
8. "Aromatic selenonium bases." By Samuel Smiles and Thomas Percy Hilditch.

When anisole or phenetole are heated on the water-bath with selenium dioxide and aluminium chloride, the chlorides of the corresponding selenonium bases are formed. To isolate these substances, the reaction mixture is decomposed with water and freed from excess of phenolic ether by distillation in steam; finally the mixture is extracted with chloroform which, on evaporation, leaves the chloride of the base as a red oil. *Trianisyl-* and *triphenetyl-selenonium chlorides* are viscous oils, the aqueous solutions of which yield strongly basic *hydroxides* on treatment with silver oxide. The *iodides* are sparingly soluble oils. The *platinichlorides* were obtained as brown precipitates, insoluble in water and very soluble in acetone. The *platinichloride* of *triphenetylselenonium* melts at 82—83°. The dichromates of these bases are insoluble in water and are precipitated in yellowish-brown flakes when an acid solution of potassium chromate is added to solutions of the chlorides. They are very unstable and turn dark on exposure to the air. *Trianisylselenonium dichromate* melts at 65—70°.

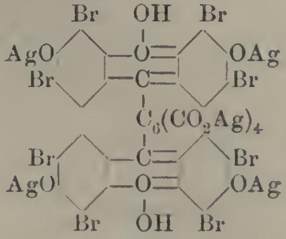
9. "The relation of colour and fluorescence to constitution." By Arthur George Green.

In a paper bearing the above title (*Trans.*, 1906, **87**, 1787), O. Silberrad has recently described a number of complex phthaleins formed by the condensation of mellitic and pyromellitic acids with resorcinol. From the fact that the silver salts of these phthaleins correspond to the substitution of hydrogen by silver, not only in all the carboxyl groups of the mellitic residue, but also in the two phenolic hydroxyl groups of each xanthene ring, it is concluded that "neither the colour nor the fluorescence of these compounds is dependent on the presence of quinone linkings, for in many cases a quinonoid structure is impossible." This conclusion Silberrad is inclined to extend to the phthaleins in general.

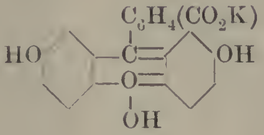
A study of the phthaleins of phenol and quinol, which the author has had in progress for some time past, has brought to light several facts pointing to an opposite conclusion and strongly confirming the view that the coloured salts of these phthaleins have a quinonoid structure. It therefore appears advisable to point out that Silberrad's deductions are in no sense necessary, but that on the contrary his compounds may be represented with equal or greater probability upon a quinonoid type. For instance, in place of the carbinol formula (I) for the silver salt of the octabromohexahydroxy-*p*-dixanthylbenzenetetracarboxylic acid, the orthoquinone formula (II) may be substituted. The latter is analogous to (III), the formula proposed by the author for the potassium salt of quinolphthalein (*Ber.*, 1906, 39, 2365):



(I.)



(II.)

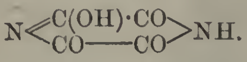


(III.)

10. "Tetraketopiperazine." By Alfred Theophilus de Mouilpied and Alexander Rule.

The authors have studied the action of sodium alkyloxides on esters of the type of ethyl oxamate, $NH_2\cdot CO\cdot CO_2Et$, whereby the elimination of 1 molecule of alcohol would be expected to give rise to ring compounds containing an imino-group. Ethyl oxamate should by such a reaction furnish oxalimide, $\begin{matrix}CO\\ |\\ CO\end{matrix}\!\!>\!NH$, which is referred to by Ost and Mente (*Ber.*, 1886, 19, 3228), but its existence appears to be very doubtful. The authors were not able to obtain it, but prepared from ethyl oxamate, *tetraketopiperazine*, which has twice the molecular weight of oxalimide and which seems to be the substance described under the latter name.

Tetraketopiperazine was also obtained by the condensation of ethyl oxalate with oxamide; a *hydrazone*, *silver* and *sodium* salts have been prepared, and the following constitutional formula is suggested:



$$N\lessdot\begin{matrix}C(OH)\cdot CO\\ CO\text{——}CO\end{matrix}\!>\!NH.$$

Methyl succinamate yields succinimide by a similar reaction, and ethyl malonamate gives a *substance* of formula $C_6H_8O_5N_2$, resulting from the condensation of 2 molecules of malonamic acid through loss of 1 molecule of water.

A general method for the preferential saponification of a carboxy-alkyl group occurring in the same compound with an acid amide group was described.

Saponified with alkali in the usual way, ethyl oxamate yields the semi-ethyl ester and oxalic acid, and ammonia is simultaneously evolved. By using the theoretical amount of pure sodium alkyloxide in dry benzene solution a large yield of sodium oxamate is obtained.

11. "Transformations of highly substituted nitroaminobenzenes. II. *s*-Tribromo-1-nitroaminobenzene." By Alice Emily Smith and Kennedy Joseph Previté Orton.

Treatment of 2 : 4 : 6-tribromo-1-nitroaminobenzene,

$$C_6H_2Br_3\cdot NH\cdot NO_2,$$

with sulphuric acid or a mixture of sulphuric and acetic acids leads to the replacement of a bromine atom by the nitro-group, and to the formation of 2 : 6-dibromo-4-nitroaniline (*Trans.*, 1902, **81**, 806). Within very narrow limits of temperature and concentration of the sulphuric acid, the nitroamine is partly converted into bromophenyliminobenzoquinones, analogous to the hexachlorophenyliminobenzoquinone obtained from *s*-trichloronitroaminobenzene (*Trans.*, 1905, **87**, 389). In the case of the bromo-compounds, however, a mixture of two phenyliminobenzoquinones is always formed, namely, a penta- and a hexa-bromo-derivative, $C_6H_2Br_3\cdot N\colon C_6H_2Br_2\colon O$ and

$$C_6H_2Br_3\cdot N\colon C_6HBr_3\colon O\ ;$$

bromine is accordingly set free in the reaction.

s-*Tribromophenyliminodibromobenzoquinone* crystallises in dark red prisms or needles with a metallic lustre, and melts at 171°. On reduction it yields s-*tribromophenyldibromo-4-hydroxyphenylamine*, which crystallises in white, silky needles melting at 155—156°, and is freely soluble in alcohol and other solvents. The latter can thus be separated from the s-*tribromophenyltribromo-4-hydroxyphenylamine*, which crystallises in colourless needles or prisms melting at 206°. On oxidation it is converted into s-*tribromophenyliminotribromobenzoquinone*, which crystallises in pale red needles or prisms melting at 134—135°, and is more soluble than the pentabromo-derivative in all the usual solvents.

12. "Resolution of tetrahydro-*p*-toluquinaldine into its optically active components." By Thomas Constantine Beck and William Jackson Pope.

The *d*-*αβ*-bromocamphorsulphonic acid of Armstrong and Lowry was shown to be applicable for the resolution of externally compensated bases, in accordance with the method of Pope and Peachey, by using it for the separation of the optically active tetrahydro-*p*-toluquinaldines from the corresponding externally compensated mixture. By treating two equivalents of *dl*-tetrahydro-*p*-toluquinaldine hydrochloride with one equivalent of the ammonium salt of the Armstrong and Lowry acid, under appropriate conditions, a nearly quantitative separation of *d*-tetrahydro-*p*-toluquinaldine-*d*-*αβ*-bromocamphorsulphonate is obtained; the salt gives the value $[M]_D + 445°$ in aqueous solution. On treating the base retained by the mother liquors with Kipping and Pope's *d*-bromocamphorsulphonic acid, nearly the whole of the *l*-base can be separated in a pure state as described by Pope and Rich.

The molecular rotatory powers of a number of salts of the optically active bases have been examined and found to be in agreement with previous conclusions concerning these values for salts of strong optically active bases with strong acids.

13. "Note on the theory of valency." By William Barlow and William Jackson Pope.

The homogeneous, close-packed assemblages of spheres corresponding to a series of homologous compounds, such as, for instance, the normal paraffins, are characterised by similarity of marshalling. Further, the assemblage representing ethane is derived from that of methane (*Trans.*, 1906, **89**, 1743) by an application of the second geometrical property (*loc. cit.*, 1729); the substitution of one carbon sphere of volume 4 for a hydrogen sphere of volume 1 in each unit, CH_4, of the partitioning of the methane assemblage necessitates the simultaneous addition of three hydrogen spheres in accordance with the second geometrical property, so that each unit of the ethane partitioning assumes the composition C_2H_6.

The empirical compositions, CH_3 and CH_4, of the ethane and methane assemblages differ, however, by one hydrogen sphere and a case is thus provided in which, so far as the packing of the spheres is concerned, two hydrogen spheres of volume 1 in the methane assemblage perform the functions of one hydrogen sphere of volume 1 in the ethane assemblage. This is therefore a case of the kind which Mr. D. L. Chapman (*Proc.*, 1906, **22**, 320) considers to offer difficulty in connexion with our theory of valency and to necessitate some modification of the fundamental assumptions. From the fact that the methane and ethane assemblages are related through the second geometrical property, it is, however, clear that the application of Mr. Chapman's argument to an actual instance merely brings out the very close correspondence between the geometrical properties in question and our knowledge of chemical constitution.

Just as the bearings of the doctrine of valency on constitution and substitution do not appear when empirical compositions are considered, so the second geometrical property only serves to elucidate the doctrine of valency when it is applied in connexion with the molecular composition or the composition of the unit of the geometrical partitioning of the assemblage. A number of examples of the mode in which the property is applied have been already given (*loc. cit.*, 1729—1736).

We may perhaps be allowed to take this opportunity of emphasising the statement (*loc. cit.*, 1691 and 1698) that the geometrical properties and the assemblages, which latter are for diagrammatic purposes represented as if composed of undeformed spheres, are in every case supposed to be subject to the condition that so much general pressure is operative on the system as practically to eliminate the interstitial space. It is, of course, not conceivable that the space occupied by the spheres of influence of a group of atoms in contact should include space unavailable for occupation by the atoms.

14. "The condensation products of triacetic lactone with aceto-acetic ester and β-aminocrotonic ester." By Frederick Noel Ashcroft Fleischmann.

Triacetic lactone condenses in presence of strong sulphuric acid and hydrochloric acid, &c., with aceto-acetic ester, to form a *pyrone-lactone*, $C_{10}H_8O_4$, melting at 214°. The substance is extremely stable towards acids, but unstable in presence of alkalis, with which it forms deep yellow solutions. It yields a stable *bromo*-compound (m. p. 190°) crystallising from benzene with benzene of crystallisation, and a *nitro*-derivative (m. p. 200° approx.) which on treatment with strong aqueous ammonia yields aminodehydracetic acid. An unstable abnormal *barium* salt was also prepared, from which an insoluble, unstable *silver* and a *mercuric* salt were obtained.

A similar condensation takes place between triacetic lactone and β-aminocrotonic ester in presence of sulphuric, hydrochloric, or glacial acetic acids. The same pyrone-lactone is produced and, in the last instance, a second compound corresponding to the formula $C_{16}H_{19}O_6N$, the constitution of which is proved by its yielding the ethyl ester of ψ-lutidostyrilcarboxylic acid on treatment with alcoholic potash.

15. “Derivatives of multivalent iodine. Part II. Action of heat on *p*-iodoacetophenone dichloride, *p*-iodoacetanilide dichloride, and on the dichlorides derived from *o*-, *m*-, and *p*-iodotoluene.”

By William Caldwell and Emil Alphonse Werner.

One of us (Werner, *Trans.*, 1906, 89, 1632) has shown that *p*-iodoacetophenone dichloride and *p*-iodoacetanilide dichloride when heated decompose with probable formation of substitution derivatives, thus differing from the general decomposition which has been hitherto recognised in connexion with the chlorides derived from tervalent iodine.

When *p*-iodoacetophenone dichloride, $CH_3{\cdot}CO{\cdot}C_6H_4{\cdot}ICl_2$, is heated (Werner, *Trans.*, 1906, 89, 1632) it decomposes suddenly at 93—94°, only traces of chlorine (0·43 per cent.) being evolved in the free state, and *chloro*-p-*iodoacetophenone* is produced to the extent of 98 per cent. of the theoretical, thus:

$$CH_3{\cdot}CO{\cdot}C_6H_4{\cdot}ICl_2 = CH_2Cl{\cdot}CO{\cdot}C_6H_4I + HCl.$$

It forms long, slender prisms (m. p. 126—127°), and on oxidation it furnishes *p*-iodobenzoic acid. With chlorine it yields

$$CH_2Cl{\cdot}CO{\cdot}C_6H_4{\cdot}ICl_2,$$

which decomposes at 128—130° with production of *dichloro*-p-*iodoacetophenone*, $CHCl_2{\cdot}CO{\cdot}C_6H_4I$ (m. p. 62—63°). This also gives *p*-iodobenzoic acid on oxidation and unites with chlorine to form

$$CHCl_2{\cdot}CO{\cdot}C_6H_4{\cdot}ICl_2,$$

which is decomposed by heat with evolution of most of the chlorine in the free state.

p-Iodoacetanilide dichloride, $CH_3{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}ICl_2$, decomposes at 105° and yields *chloro*-p-*iodoacetanilide*, $CH_3CO{\cdot}NH{\cdot}C_6H_3ClI$ (m. p. 144°), from which a *chloroiodoaniline*, $C_6H_3ClI{\cdot}NH_2$ ($NH_2 : I : Cl = 1 : 4 : 2$ or 3) (m. p. 73°), is obtained. The *picrate* melts at 132°.

Chloro-*p*-iodoacetanilide unites with chlorine, forming

$$CH_3CO{\cdot}NH{\cdot}C_6H_3Cl{\cdot}ICl_2,$$

which decomposes at 131° and yields a substitution product which has not yet been investigated.

The action of heat on the chlorides of *o*-, *m*-, and *p*-iodotoluenes, prepared by Willgerodt, has been examined.

o-Tolyliodochloride decomposes at 85—86° and yields *o*-iodobenzyl chloride, $C_6H_4I{\cdot}CH_2Cl$, which gives *o*-iodobenzoic acid on oxidation.

m-Tolyliodochloride decomposes at 88°, giving an iodochloride which yields on oxidation an acid melting at 210° and containing both chlorine and iodine.

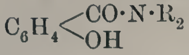
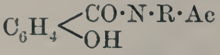
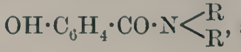
p-Tolyliodochloride decomposes at 110°, giving *p*-iodobenzyl chloride. In each case a small proportion of the original iodotoluene is regenerated.

16. "Disalicylamide." By James McConnan.

O-Salicylsalicylamide does not possess the properties previously attributed to it (*Patentschrift* No. 111, 656); the compound thus named by Cohn was probably disalicylamide.

Under suitable conditions, *O*-salicylsalicylamide rearranges, forming disalicylamide and *vice versâ*; this is another case of the metoxazone tautomerism peculiar to acyl derivatives of salicylamide, and already studied in the cases of the benzoyl and the acetyl derivatives (McConnan and Titherley, *Trans.*, 1906, **89**, 1318).

17. "Benzoyl derivatives of *N*-methylsalicylamide." By James McConnan and Morris Edgar Marples.

N-*N*-Dimethylsalicylamide is a stable substance; *N*-methyl-*N*-benzoylsalicylamide, however, is unstable, and under the conditions of its formation it is either instantly hydrolysed or rearranges, forming *N*-methyl-*O*-benzoylsalicylamide. It thus appears that, although derivatives of the general formula  $C_6H_4<\begin{matrix}CO\cdot N\cdot R_2\\ OH\end{matrix}$ are stable, substances of the type  $C_6H_4<\begin{matrix}CO\cdot N\cdot R\cdot Ac\\ OH\end{matrix}$ are too unstable to permit of isolation. This result is of considerable interest, since McConnan and Titherley have already shown (*Trans.*, 1906, **89**, 1327) that *N*-*N*-diacylsalicylamides,  $OH\cdot C_6H_4\cdot CO\cdot N<\begin{matrix}R\\ R\end{matrix}$, are too unstable to exist.

18. "The velocity of reaction of bromine with some unsaturated acids in aqueous solution." By Ernest Barrett and Arthur Lapworth.

Recent communications from W. Herz and B. Mylius (*Ber.*, 1906, **39**, 3816) and from J. J. Sudborough and J. Thomas (*Proc.*, 1906, **22**, 318) deal with the addition of bromine to cinnamic acid and its esters in organic solvents. We have been engaged in the examination of addition of bromine to some unsaturated acids in aqueous solutions in the hope of throwing some light on the mechanism of such reactions.

The changes are somewhat difficult to follow, as the velocities are very considerable, and even in dilute solutions the time must be measured in seconds instead of hours. The temperature employed was 14·9° in the first three cases and 25·5° with the monobromocinnamic acids, and the experiments were carried out in artificial light.

Cinnamic Acid.—With equimolecular proportions of acid and halogen in *N*/1000 solutions, nearly the whole of the bromine disappeared in thirty seconds. With excess of bromine, 1·5 mols. were absorbed in about eighty minutes, this effect being due to the formation of bromocinnamic acids from the initial product. With crotonic acid and bromine, in equimolecular proportions in *N*/200 solutions, more than 9/10ths of the bromine was used in forty-five seconds.

Benzylidenemalonic Acid.—With *N*/200 solutions, about 0·5 mol. of bromine was absorbed in one minute, and the change had during the greater part of its course the form of a termolecular reaction. With the sodium salt the velocity is much greater, 9/10ths of the bromine disappearing in about thirty seconds. In *N*/2 sulphuric acid the velocity was about 1/10th of its usual value. Potassium bromide also lowers the reaction velocity, but not so decidedly; thus in *N*/2 potassium bromide the velocity was about 3/5ths of its ordinary value.

The reaction, towards its end, is complicated, the product losing hydrogen bromide and carbon dioxide, the resulting bromocinnamic acid accounting for some of the bromine. Thus with excess of bromine, $1\frac{1}{4}$ mols. of halogen disappeared in twenty minutes.

β-Monobromocinnamic Acid.—With equimolecular proportions of acid and bromine in *N*/100 solutions, about 0·25 mol. of bromine disappeared during the first half-minute. The change, in presence of excess of hydrogen chloride or potassium chloride, is of the bimolecular form; in absence of these agents the decomposition of the initial addition product occurs with measurable speed. The sodium salt is brominated at about the same rate as the free acid at first, but later the secondary reactions are more evident. Hydrogen chloride or potassium bromide diminish the reaction velocity, but apparently never to more than half the normal value. In this case, mineral acids have considerably less effect than have bromides, an observation consistent with the fact that the sodium salt and the acid have nearly the same velocity of bromination. The sodium salt of the stereoisomeric *a-monobromocinnamic acid*, it is interesting to note, absorbs bromine many times more rapidly than does the free acid.

The results appear inconsistent with the view that bromine dissociates into ions before addition at a double linking. They seem to show, however, that the ions of the acids, as well as the acids themselves, unite with bromine directly.

19. "Note on the molecular complexity of liquids." By Albert Ernest Dunstan and Ferdinand Bernard Thole.

In a recent paper (*Trans.*, 1906, 89, 1774) Holmes deals with the question of molecular complexity from the point of view of the volume changes produced on mixing. By calculating the greatest difference between the volume of alcohol actually present and the volume which would be present assuming no contraction, he assumes, for mixtures of alcohol and water, for example, that this maximum ($1C_2H_5{\cdot}OH,1H_2O$) implies approximation of the ratio of the radii of "influential spheres" to unity.

The following table shows that the ratio does not approximate to unity, taking as a basis of calculation the true molecular volumes given by the author:

	Mol. vol.	Max. difference of alcohol percentages by vol. at:	Above ratio of radii.
Ethyl alcohol	3·22	$C_2H_5{\cdot}OH,1\frac{1}{4}H_2O$	$\sqrt[3]{\frac{3{\cdot}22}{1}} = 1{\cdot}47.$
n-Propyl alcohol	4·07	$C_3H_7{\cdot}OH,1\frac{1}{2}H_2O$	$\sqrt[3]{\frac{4{\cdot}07}{1}} = 1{\cdot}60.$
Propionic acid	4·06	$C_2H_5{\cdot}CO_2H,1H_2O$	$\sqrt[3]{\frac{4{\cdot}06}{1}} = 1{\cdot}59.$
n-Butyric acid	5·08	$C_3H_7{\cdot}CO_2H,1H_2O$	$\sqrt[3]{\frac{5{\cdot}08}{1}} = 1{\cdot}72.$

Throughout the paper the author refers to the one constituent of a mixture as possessing the more active molecule usually of greater molecular volume and carrying a preponderating effect into the mixture. It would be more correct to look upon solution from the point of view of the reciprocal effect of the one component on the other; when this is done, for example, in the case of alcohol and water, the maximum effects are to be noticed at the proportions $1C_2H_5{\cdot}OH,3H_2O$ (Dunstan, *Trans.*, 1904, **85**, 823).

Holmes regards the lower alcohols and acids of the paraffin series, from similar considerations, as having the same complexity as water; water he assumes to have the aggregate formula $(H_2O)_2$. Now there is a considerable amount of evidence available which shows that the earlier liquids of homologous series tend to associate somewhat particularly those the members of which are hydroxylated.

It has been shown that the quantity $\frac{\text{Viscosity}}{\text{Mol. vol.}} \times 10^6$ is nearly constant, viz.: 60 for such liquids as are currently accepted as unimolecular, but for the hydroxylated associated class the values are much in excess of 60 (Dunstan, *Zeit. physikal. Chem.*, 1905, **51**, 732):

Benzene	65	Water	493	Acetic acid	195
Chloroform	67	Methyl alcohol	138	Glycerol	106,000
Carbon disulphide	60	Ethyl alcohol	189		

Again, when viscosity coefficients are plotted against molecular weights, not only do the alcohols and acids relatively stand apart from the unimolecular liquids, but also the curves show such divergences at the beginnings of the series as to justify the idea of increased association.

Glycerol and nicotine are the only unimolecular liquids quoted in the table (p. 1785); now glycerol is not only notably viscous, but also has a remarkably high temperature coefficient of viscosity; both these facts indicate its association.

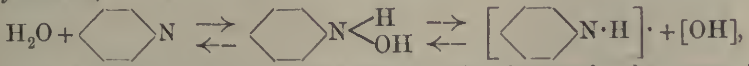
Carbon disulphide (*loc. cit.*) is mentioned as possessing four times the complexity of alcohol and is therefore represented by the formula $[CS_2]_8$; it is inconceivable from such data as, for example, its low boiling point, its low viscosity coefficient, the variation of its molecular surface energy with temperature, and its position in the molecular weight-viscosity chart.

Pyridine is quoted as a liquid which has the same molecular complexity as water and the alcohols. If this is so it is extraordinary that the viscosity concentration curves of mixtures of pyridine with alcohol on the one hand and with water on the other should be so entirely different. From an investigation now in progress on pyridine solutions it is found that in aqueous solution a maximum occurs at the proportions $2C_5H_5N,5H_2O$, and secondary irregularities at

$$3C_5H_5N,2H_2O,$$

$$2C_5H_5N,7H_2O,\ 1C_5H_5N,5H_2O,\ \text{and}\ 1C_5H_5N,10H_2O.$$

These discontinuities can only be explained by the assumption of loosely held complexes in dynamic equilibrium, which ionise to a considerable extent, and which generally behave like ammonium hydroxide,



but in alcoholic solution no maximum point is noted; the curve is composed of two branches which represent (1) the viscosity curve of associated alcohol with dissociated pyridine, and (2) dissociated alcohol with associated pyridine.

A precisely similar curve is afforded by alcohol–benzene mixtures. A study of the viscosity curves (Dunstan, *Trans.*, 1905, **87**, 11, and *loc. cit.*) enables the changes in association which take place to be followed qualitatively, whilst the curves connecting molecular weight with viscosity coefficient give a quantitative idea as to the degree of association existing in any given liquid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Gibbs, *J. Willard.* The scientific papers of J. Willard Gibbs. (Edited by *Henry Andrews* **Bumstead** and *Ralph Gibbs van* **Name.**) 2 vols. pp. xxviii + 434, ix + 284. London 1906. (*Recd.* 3/1/7.)
From the Publishers: Messrs. Longmans, Green & Co.

Japp, *Francis Robert* and **Maitland,** *William,* **Knox,** *Joseph,* **Wood,** *James.* Researches in organic chemistry carried out in the University of Aberdeen. pp. iv + 86. Aberdeen 1905. (*Recd.* 15/1/7.)
From the University of Aberdeen.

Meldrum, *Andrew N.* Avogadro and Dalton. The standing in chemistry of their hypotheses. With a preface by *Francis R.* **Japp.** pp. viii + 113. Aberdeen 1904. (*Recd.* 15/1/7.)
From the University of Aberdeen.

Meyer, *Ernst von.* A history of chemistry from earliest times to the present day, being also an introduction to the study of the science. Translated by *George* **McGowan.** Third English edition. pp. xxvii + 691. London 1906. (*Recd.* 10/1/7.) From Dr. George McGowan.

Thresh, *John C.* and **Porter,** *Arthur E.* Preservatives in food and food examination. pp. xv + 484. ill. London 1906. (*Recd.* 29/12/6.)
From Dr. J. C. Thresh.

Vicarey, *R. W.* The treatment of storage batteries. pp. xi + 58. ill. London 1907. (*Recd.* 12/1/7.) From the Author.

II. *By Purchase.*

Dowson, *J. Emerson,* and **Larter,** *A. T.* Producer gas. pp. xiv + 295. ill. London 1906. (*Recd.* 9/1/7.)

III. *Pamphlets.*

Caldwell, *Robert J.* The hydrolysis of sugars. [A paper read before the York Meeting of the British Association, 1906.] pp. 26.

Crompton, *Holland.* Some molecular and latent heats. pp. 12. Salcombe 1906.

Finlow, *R. S.* The extension of jute cultivation in India. (From the *Bull. Agricultural Research Inst., Pusa,* 1906.)

Hughes, *Frank.* The occurrence of sodium salts in Egypt. With special reference to nitrate of soda. (From the *Yearbook, Khedivial Agric. Soc., Cairo.* 1905.)

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on Friday, March 22nd, 1907, this being the day fixed for the Annual General Meeting. Further particulars will be announced shortly.

At the next Ordinary Meeting on **Thursday**, February **7th**, 1907, the following papers will be communicated:

"The rapid electro-analytical deposition and separation of metals. Part I. The metals of the silver and copper groups and zinc." By Henry Julius Salomon Sand.

"The alkaloids of ergot." By G. Barger and F. H. Carr.

"Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part VI. The partially methylated 4:6-diamino-*m*-xylenes." By G. T. Morgan and F. M. G. Micklethwait.

"The reduction of hydroxylaminodihydroumbelluloneoxime." By F. Tutin.

"The constitution of umbellulone. Part II. The reduction of umbellulonic acid." By F. Tutin.

"Studies on optically active carbimides. Part V. The aryl esters and the amides of *l*-menthylcarbamic acid." By R. H. Pickard and W. Oswald.

"Some constituents of natural indigo. Part. I." By A. G. Perkin and W. P. Bloxam.

"The occurrence of isatin in some samples of Java indigo." By A. G. Perkin.

"On the absorption spectra of benzoic acid, the benzoates, and benzamide." By W. N. Hartley and E. P. Hedley.

"The absorption spectra of phthalic, *iso*phthalic, and terephthalic acids. Phthalic anhydride and phthalimide." By W. N. Hartley and E. P. Hedley.

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Issued 15/2/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 320.

Thursday, February 7th, 1907, at 8.30 p.m., Professor R. Meldola, F.R.S., President, in the Chair.

Mr. H. S. Redgrove was formally admitted a Fellow of the Society.

The President gave expression to the deep sense of loss experienced by Fellows of the Society through the death, on February 2nd, of Professor Dmitri Ivanovitsch Mendeléeff, F.R.S., and of Professor Nicolai Menschutkin, which occurred on February 5th. These chemists were Honorary and Foreign Members of the Society, having been elected in 1883 and 1898 respectively.

Certificates were read for the first time in favour of Messrs. :

John Campbell Allan, 91, Norse Road, Scotstoun, Glasgow.
Francis James Bailey, Findon Hill, Sacriston, Durham.
Charles Stanley Gibson, B.A., 45, Shakespeare Street, Manchester.
Joshua Craven Gregory, B.Sc., F.I.C., 126, Woodlands Road, Glasgow.
John Robinson, Agricultural College, Aspatria, Cumberland.

Of the following papers, those marked * were read :

*20. "The rapid electro-analytical deposition and separation of metals. Part I. The metals of the silver and copper groups and zinc." By Henry Julius Salomon Sand.

The experiments on a new electro-analytical method of rapid determination and separation of metals referred to in a preliminary note (*Proc.*, 1906, **22**, 43) have been continued. The metals hitherto studied are silver, mercury, copper, bismuth, lead, cadmium, and zinc. With the exception of the separation silver–mercury, each metal has been successfully separated from all the others by the method of graded potential. In order to separate silver from mercury the metals were deposited together, converted into their cyanides, and these separated in the usual way by means of their different behaviour to acids. The silver was then estimated electrolytically in the pure silver cyanide obtained. Experiments have been carried out in which the seven metals studied have been quantitatively separated from one solution. The silver was separated from the mercury as described above, and the lead and part of the bismuth were removed on the anode. All the other separations were brought about by graded potential. The metals were deposited in the following sequence. 1. Mercury and silver. 2. Lead and part of bismuth on anode ;—copper and rest of bismuth on cathode. 3. Cadmium. 4. Zinc. 5. After dissolving the combined deposit of copper and bismuth, the latter was estimated. 6. Rest of bismuth separated from lead after dissolving the deposit. 7. Lead. 8. Cadmium tested for traces of lead. One evaporation was necessary. The time required for the depositions in these experiments varied between five and fifteen minutes.

Discussion.

Mr. Edward Gardner asked if the author had had any experience in depositing copper from solutions containing a large quantity of ferric sulphate, and whether he had been able, in such solutions, to obtain an adherent deposit by any method of graded potential.

Mr. Sand stated that the presence of metals of variable valency, such as iron, which pass from one stage of oxidation to another with extreme readiness caused much difficulty. Work on such cases was being carried out at present.

*21. "The alkaloids of ergot."

By George Barger and Francis Howard Carr.

The authors assign to Tanret's crystalline ergotinine the formula $C_{35}H_{39}O_5N_5$, and have abandoned the formula $C_{28}H_{32}O_4N_4$ provisionally suggested in a preliminary note communicated to the British Association (*Chem. News,* 1906, **94**, 89). Tanret's original formula, $C_{35}H_{40}O_6N_4$, was based on faulty nitrogen determinations. In the above-mentioned note, the authors suggested the name ergotoxine for a second amorphous ergot alkaloid, of which they had crystallised several salts. Subsequently this alkaloid was described by Kraft (*Arch. Pharm.*, 1906, **244**, 336) as hydroergotinine, because by boiling its solution in methyl alcohol it was converted into ergotinine. Kraft did not analyse hydroergotinine.

In an attempt to acetylate ergotoxine with acetic anhydride the authors obtained ergotinine. As the latter alkaloid contains no acetyl group the change must be due to dehydration. The reverse change occurs when an ergotinine solution in dilute phosphoric acid is boiled. The crystalline phosphate of an amorphous alkaloid is then formed, closely resembling ergotoxine phosphate.

For ergotoxine the formula $C_{35}H_{41}O_6N_5$ is deduced from the analyses of the free base and of the following crystalline salts:
$C_{35}H_{41}O_6N_5,HCl$, m. p. 205°; $C_{35}H_{41}O_6N_5,H_3PO_4,H_2O$, m. p. 186—187°; $C_{35}H_{41}O_6N_5,C_2H_2O_4$, m. p. 179°, and $(C_{35}H_{41}O_6N_5)_2,C_2H_2O_4$, m. p. 179°.

The two formulæ, $C_{35}H_{39}O_5N_5$ and $C_{35}H_{41}O_6N_5$, thus independently arrived at for the crystalline and the amorphous alkaloid respectively establish the theory, first put forward by Kraft, that the former is the anhydride of the latter.

In contradistinction to ergotinine, ergotoxine is strongly active physiologically, producing all the typical effects of ergot. It is contained in most commercial specimens of ergotinine and also in Tanret's so-called "amorphous ergotinine."

Discussion.

Dr. Bywaters asked whether other alkaloids were known which passed from an inactive to an active form by being simply hydrated, and whether the fact of the active alkaloid being amorphous and forming a colloidal solution did not indicate that it was rather polymerisation instead of hydration that had occurred.

Dr. Barger stated that some alkaloids were known which behaved similarly to those mentioned in the paper. The salts of both alkaloids formed colloidal solutions under certain conditions.

*22. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part VI. The partially methylated 4 : 6-diamino-*m*-xylenes." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

In examining the effect of substitution on the formation of *o*-aminoazo-compounds of the benzene series, the authors have methylated progressively 4 : 6-diamino-*m*-xylene and have studied the action of diazonium salts on the products. *Methyl*-4 : 6-*diamino*-m-*xylene* yields azo-derivatives like the unmethylated diamine itself, but as-*dimethyl*-4 : 6-*diamino*-m-*xylene* and *trimethyl*-4 : 6-*diamino*-m-*xylene* furnish stable diazoamines which are accompanied only by traces of azo-compounds.

Discussion.

The President congratulated Dr. Morgan on the extreme ingenuity of the method by which he had effected the progressive methylation of these substituted *meta*-diamines. He asked with reference to the possible formation of aminoazo-compounds with the azo- and dimethylamino-groups in the *ortho*-position whether the action of the usual transforming agents on the corresponding diazoamines had been tried, and if so with what result.

In reply to Dr. Cain's suggestion that steric hindrance might be the cause of the non-formation of azo-derivatives from tetramethyl-4 : 6-diamino-*m*-xylene, Dr. Morgan preferred to take the view that the absence of a labile hydrogen atom attached to nitrogen was the inhibiting factor. The non-formation of *ortho*azo-derivatives from tertiary amines was a general rule which held both in the benzene and naphthalene series, whereas the phenomena attributed to steric hindrance in one of these series were frequently not manifested in the other.

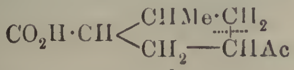
In reply to the President he stated that repeated attempts to transform the diazoamines of the *as*-dimethyl- and trimethyl-4 : 6-diamino-*m*-xylenes had not led to the isolation of definite aminoazo-compounds.

*23 "The constitution of umbellulone. Part II. The reduction of umbellulonic acid." By Frank Tutin.

When umbellulonic acid, $C_9H_{14}O_3$, obtained by the oxidation of umbellulone (*Trans.*, 1906, 89, 1104), is reduced by means of sodium and alcohol, a *hydroxy-acid* having the formula $C_9H_{18}O_3$ is produced. It is evident from this fact that the ring contained in umbellulonic acid has been opened by the addition of two atoms of hydrogen, and the resulting hydroxy-acid must therefore be a chain compound.

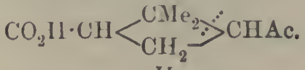
This hydroxy-acid gives a *lactone* (b. p. 246—248°), and when oxidised with permanganate in presence of an excess of alkali yields acetic and *iso*propylsuccinic acids.

In the previous communication (*loc. cit.*) it was shown that umbellulonic acid must contain either a methylpentamethylene or a dimethyltetramethylene ring. Only two keto-acids containing either of these rings are capable of giving on reduction a hydroxy-acid, which, by subsequent oxidation, would yield acetic and *iso*propylsuccinic acids, namely, those possessing the following formulæ :



$CO_2H\cdot CH<\begin{matrix}CHMe\cdot CH_2\\ CH_2—CHAc\end{matrix}$

I.



$CO_2H\cdot CH<\begin{matrix}CMe_2\\ CH_2\end{matrix}>CHAc.$

II.

A hydroxy-acid which would yield on oxidation acetic and *iso*propylsuccinic acids, could only be formed from one of the above keto-acids by the opening of the ring on reduction at the place indicated by the dotted line. The product of the reduction of umbellulonic acid will therefore be *δ-hydroxy-α-*iso*propyl-*n*-hexoic acid*,

$$CH_3\cdot CH(OH)\cdot CH_2\cdot CH_2\cdot CH\cdot(CO_2H)\cdot CH(CH_3)_2.$$

Formula II represents pinononic acid, and it has previously been shown that umbellulonic acid is neither identical nor stereoisomeric with this compound. Umbellulonic acid must, therefore, be correctly represented by formula I.

It follows from this that the correctness of the formula previously assigned to umbellulone cannot be doubted.

*24. "The reduction of hydroxylaminodihydroumbelluloneoxime."

By Frank Tutin.

Hydroxylaminodihydroumbelluloneoxime was prepared by Power and Lees in their investigation of the essential oil of *Umbellularia Californica* (*Trans.*, 1904, **85**, 636). When reduced with sodium and alcohol it gives a *base* (b. p. 136—138°/50 mm.), which is a liquid soluble in water. From the results obtained by the analysis of the *dibenzoate, dihydrochloride*, and *dibenzoyl* derivative of this base it is impossible to say with certainty whether it has the formula $C_{10}H_{20}N_2$ or $C_{10}H_{22}N_2$, although it is most probable that the latter is correct. The base may therefore be designated *aminotetrahydroumbellulylamine.*

Aminotetrahydroumbellulylamine dibenzoate crystallises in needles melting at 212—213°; the *dihydrochloride* also forms needles, but it is infusible at 305°. *Dibenzoylaminotetrahydroumbellulylamine* crystallises in prisms or in leaflets, which melt at 194°.

Although evidence was obtained of the presence of bases which are probably stereoisomeric with aminotetrahydroumbellulylamine, no derivative of them could be isolated in a state of purity.

25. "Studies on optically active carbimides. Part V. The aryl esters and the amides of *l*-menthylcarbamic acid." By Robert Howson Pickard and William Oswald Littlebury.

A continuation of the investigation of derivatives of menthylamine (see *Proc.*, 1905, **21**, 286). Eleven aryl esters and eighteen amides of *l*-menthylcarbamic acid were described and the rotations of these when dissolved in chloroform and pyridine compared. Attention was drawn to the approximately constant molecular rotation given by certain derivatives of menthylamine and menthol.

26. "Some constituents of natural indigo. Part I."

By Arthur George Perkin and William Popplewell Bloxam.

Indigo-brown, an impurity of natural indigo, is best isolated by means of boiling pyridine. The crude product contains, in addition to small quantities of indirubin and a colourless wax, certain brown amorphous substances, of which the compound (*a*), $C_{16}H_{12}O_3N_2$, is present in by far the largest amount. This substance is insoluble in all the usual solvents except pyridine, but dissolves in alkali hydroxide solutions, and is readily reduced in this condition. When digested with strong aqueous potassium hydroxide it is converted into anthranilic acid and an amorphous, brown substance of uncertain composition. Two closely-allied compounds (*b*) and (*c*) present in but small amount have been isolated, the former of which is soluble in acetic acid and insoluble in alcohol, whereas the latter dissolves in alcohol. These substances, to which the respective compositions $C_{24}H_{22}O_5N_3$ and $C_{16}H_{14}O_4N_2$ are ascribed, closely resemble in general properties the compound $C_{16}H_{12}O_3N_2$, and from them also anthranilic acid was obtained. It is considered possible that these brown compounds are derivatives or condensation products of indoxyl, which are formed from indican during the process of manufacture. The leaves of the *Indigofera arrecta* and *I. Sumatrana* are practically devoid of tannin matter.

27. "The occurrence of isatin in some samples of Java indigo."

By Arthur George Perkin.

During the examination of samples of Java indigo rich in indirubin, for yellow colouring matter (*Proc.*, 1904, **20**, 172) by extraction with sodium carbonate solution and isolation of the products from the neutralised liquid with ether, there was obtained in addition to kampherol a small amount of substance crystallising from benzene in orange needles melting at 200°. This gave the thiophen reaction and was found to consist of isatin. The quantity present was exceedingly small, and in many other samples it appeared to be absent, but the point is interesting as it indicates that the formation of indirubin during the manufacture of natural indigo follows the well known synthesis of Baeyer (*Ber.*, 1881, **14**, 1745). Indirubin appears to be most readily formed when the fermented plant extract is oxidised under slightly alkaline conditions, and in these circumstances the oxidation of a portion of the indoxyl to isatin would appear to be facilitated.

28. "The absorption spectra of benzoic acid, the benzoates, and benzamide." By Walter Noel Hartley and Edgar Percy Hedley.

The absorption spectra of benzoic acid and phthalic acid were photographed by Hartley and Huntington, and characteristic bands were found in both; those of the former being situated between λ 280 and λ 270 with a continuous absorption beyond λ 255.

In a paper by Baly and Collie (*Trans.*, 1905, **87**, 1332) it is stated that "The spectrum of benzoic acid has been observed by Hartley and Huntington (*Phil. Trans.*, 1879, **170**, I, 257) and only shows general absorption rather strongly. This is only to be expected from the presence of the ketonic oxygen in the β-position."

As many benzoyl derivatives show absorption bands in their spectra, including benzaldehyde, it was considered necessary to settle this question decisively.

The absorption curves of benzoic acid, potassium and silver benzoates, and benzamide have been drawn from the photographs of the spectra of these substances, which were specially prepared and were of great purity and finely crystallised. The absorption bands of the different substances are all obviously related to the bands in benzoic acid, and the absorption is due to the benzene ring.

29. "The absorption spectra of phthalic, *iso*phthalic, and terephthalic acids, phthalic anhydride, and phthalimide." By Walter Noel Hartley and Edgar Percy Hedley.

Phthalic acid was examined by Hartley and Huntington (*Phil. Trans.*, 1879, **170**, I, 257), but the isomeric acids have not been investigated. The sparing solubility of terephthalic acid rendered it necessary for its examination to convert it into the dimethyl ester and to examine salts of the acid. It was found that phthalic anhydride, dissolved in cold alcohol, gave no absorption band, but that after warming for five minutes the spectrum showed a marked extension, and finally a strong absorption band was developed.

Phthalimide underwent no such change; it is therefore apparent that the group $\begin{matrix}\mathrm{CO}\\\mathrm{CO}\end{matrix}\!\!>\!\mathrm{NH}$ is more stable than $\begin{matrix}\mathrm{CO}\\\mathrm{CO}\end{matrix}\!\!>\!\mathrm{O}$.

o-Phthalic acid gives an absorption curve of the character that might be expected from a comparison with that of benzoic acid and from the difference in constitution between the two.

*iso*Phthalic acid has a shallow band of absorption situated in the same position as that of phthalic acid, but it is much less persistent.

Terephthalic acid being insoluble, its dimethyl ester and salts were examined, and it was found that the acid has no band, but merely an extension at or near where a band might be expected.

30. "*ααγ*-Trimethyl- and *ααγγ*-tetramethyl-tricarballylic acids and *αδ*-dimethylbutane-*αβδ*-tricarboxylic acid." By Herbert Henstock and Charles Henry Graham Sprankling.

In a former communication by Bone and Sprankling, a method was given for the preparation of alkyl tricarballylic acids in alcoholic solution; in the case of the acids here discussed, the method has been modified and toluene was used instead of alcohol. The two reactions, (1) the condensation of the sodium compound of *β*-methylcyanosuccinic diethyl ester with *α*-bromo*iso*butyric ethyl ester, and (2) the condensation of the sodium compound of *ββ*-dimethylcyanosuccinic diethyl ester with *α*-bromopropionic ester, should both yield products from which, on hydrolysis, *ααγ*-trimethyltricarballylic acid should be obtained. It was found, however, that in reaction (1) *αδ*-dimethylbutane-*αβδ*-tricarboxylic acid is produced; probably hydrogen bromide is first eliminated from *α*-bromo*iso*butyric ester, and the resulting methylacrylic ester condenses with the sodium compound of *β*-methylcyanosuccinic ester as follows: $CO_2Et{\cdot}CHMe{\cdot}CNa(CN){\cdot}CO_2Et + CH_2{:}CMe{\cdot}CO_2Et = CO_2Et{\cdot}CHMe{\cdot}C(CN)(CO_2Et){\cdot}CH_2{\cdot}CMeNa{\cdot}CO_2Et$. Reaction (2) yields *ααγ*-trimethyltricarballylic acid.

The condensation of *ββ*-dimethylsodiocyanosuccinic diethyl ester with *α*-bromo*iso*butyric ester furnishes a product which, on hydrolysis, yields *ααγγ*-tetramethyltricarballylic acid.

31. "A reaction of certain colouring matters of the oxazine series." By Jocelyn Field Thorpe.

Those colouring matters of the oxazine series which are derivatives of phenonaphthoxazine containing amino- or substituted amino-groups in the position 6 of the phenonaphthoxazine ring, are readily converted into the corresponding phenonaphthoxazone by warming on the water-bath in the presence of very dilute acids. Thus Nile-blue A (3-diethylamino-6-aminophenonaphthoxazine sulphate) and Nile-blue 2B (3-diethylamino-6-benzylaminophenonaphthoxazine chloride) are converted into 3-diethylaminophenonaphthoxazone, melting at 204°, whereas New Methylene-blue GG (3:6-tetramethyldiaminophenonaphthoxazine chloride) and New Blue B (3-dimethylamino-6-dimethylaminophenylaminophenonaphthoxazine chloride) are converted into 3-dimethylaminophenonaphthoxazone, melting at 244°. Also those compounds which contain no substituting group in the position 6 in the phenonaphthoxazine molecule pass on warming with dilute acids into the corresponding oxazones containing the oxygen in that position. Thus, Meldola's blue (3-dimethylaminophenonaphthoxazine chloride) passes into 3-dimethylphenonaphthoxazone, melting at 244°, identical with the compound derived from New Methylene-blue GG and New Blue B.

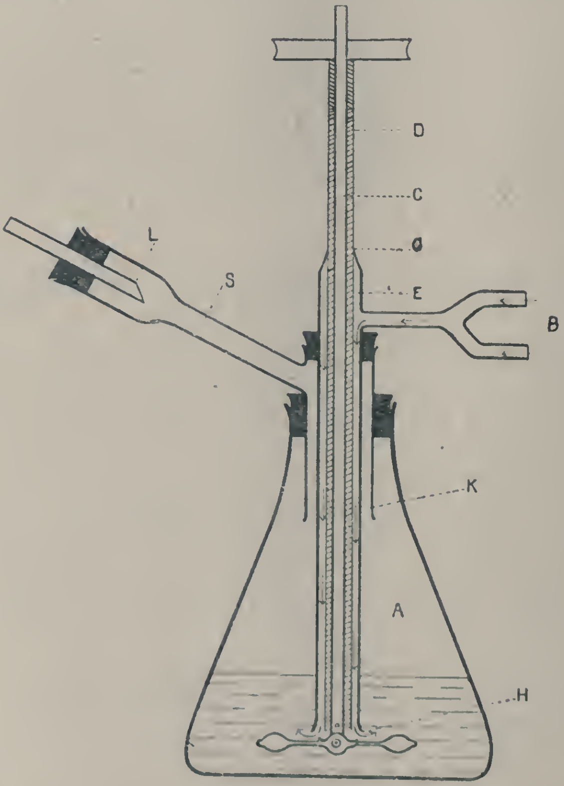
32. "The alkylation of *d*-fructose." By Thomas Purdie and David McLaren Paul.

The object of this research was to ascertain if ketoses can be alkylated by the methods already applied to aldoses, and to study the optical activity of the ketose derivatives thus obtained. Fischer's methylfructoside was methylated by means of methyl iodide and silver oxide. The resultant liquid, which had the composition of tetramethyl methylfructoside, gave on hydrolysis a liquid having the composition of tetramethyl fructose, and the properties of a reducing sugar. On realkylation, both by the silver oxide process and by Fischer's method, the substance yielded fully methylated methylfructosides. The rotatory powers of the series of compounds were abnormally low compared with that of the parent sugar. This anomaly, however, was finally explained by the isolation from the syrupy ketose of crystalline tetramethyl-α-fructose (m. p. 98—99°), which showed in alcoholic solution $[\alpha]_D^{20} -94{\cdot}2° \longrightarrow -86{\cdot}7°$. After fusion, the substance exhibits mutarotation in the opposite sense, owing to partial transformation of the α-sugar into the β-form. This compound gave liquid tetramethyl methylfructosides of high rotatory power. Evidence was obtained that the low rotatory power of the syrupy ketose was probably due to the presence of an isomeric dextrorotatory hexose, produced by isomeric change during the preparation of Fischer's methylfructoside. Evidence was also adduced for the existence of two stereoisomeric fructosides in the latter substance.

33. "A simple apparatus, with stirrer, for treating a liquid at its boiling point with two or more gases." By Norman Leslie Gebhard.

Whilst studying the action of certain gases on liquids at their boiling points, the apparatus represented in the figure was devised and found very satisfactory.

The liquid is placed in an Erlenmeyer flask *A*, of capacity appropriate to the volume of liquid under treatment. The rest of the apparatus includes a centrifugal stirrer in the liquid, driven by a water turbine through a horizontal pulley, the rod *C* carrying the stirrer rotating in an outer tube *D*. At *G*, *D* is sealed into a tube *E*, of slightly wider bore. The tube *E* reaches almost to the stirrer and dips well below the surface of the liquid. The gases enter at the tubes *B*, pass along the annular space between *D* and *E*, as indicated by the arrows, and encounter the liquid at *H* just above the stirrer. The upper part of *E*



is surrounded for part of its length by a wider tube *K* with a side tube *S*, through which the vapour of the boiling liquid passes to be condensed in the reflux condenser *L*. *E* is fitted to *K* and the latter to the flask by means of suitable corks. The apparatus enables a liquid, in vigorous ebullition, to be subjected to the action of gases, with constant stirring, and can be constructed without difficulty by anyone with a moderate knowledge of glass-blowing.

34. "Note on the arsenates of lead and calcium."

By Spencer Pickering.

Crystallised sodium arsenate of commerce consists of the disodium salt, generally united with 7, but sometimes with 12, molecules of water of crystallisation. In either case, this water may all be expelled at 100°, and decomposition into the pyro-arsenate commences at 150°. The preparations dried at 300° in accordance with the Pharmacopœia are, therefore, overheated. With lead acetate, all commercially pure samples give a precipitate of triplumbic arsenate; but with lead nitrate, the precipitate consists of the diplumbic salt, mixed, occasionally, with a certain amount of the tri- or mono-plumbic arsenates. With preparations of crude sodium arsenate, the amount of lead salt required for precipitation varies considerably, and there is an indication that a compound of the di- and tri-plumbic salts may sometimes be formed.

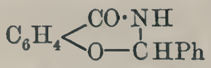
With calcium chloride or nitrate, sodium arsenate forms the tricalcium arsenate; but, when thus prepared, it is not very insoluble, and is, therefore, unsuitable as an insecticide. But it may be completely precipitated by calcium hydroxide; and thus a mixture of lime and sodium arsenate may be used as a substitute for lead arsenate.

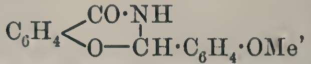
35. "Camphor-β sulphinic acid and camphorylsulphonium bases."

By Samuel Smiles and Thomas Percy Hilditch.

Camphor-β-sulphinic acid has been prepared by the reduction with zinc dust of the chloride of Reychler's camphorsulphonic acid. It was further shown that the acid when mixed with a phenolic ether and a dehydratingagent behaves in a similar manner to the aromatic sulphinic acids and yields the camphoryl sulphonium bases. The sulphinic acid and those sulphonium bases which have been prepared exhibit a strong lævorotatory power in distinction from the dextrorotatory sulphonic acid from which they were obtained. With the object of ascertaining whether this change in rotatory power is due to any alteration in structure of the camphor complex, the sulphinic acid was oxidised and and it was found that the products were the original sulphonic acid and *d*-camphoryl-α-disulphone. The authors conclude that the above change is probably caused by the conversion of the sulphur from the sexavalent to the quadrivalent state.

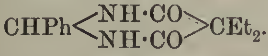
36. "The condensation of salicylamide with aryl aldehydes." By Charles Alexander Keane and William Walter Scott Nicholls.

Benzaldehyde, when heated with salicylamide in presence of hydrochloric acid or of sodium acetate, condenses to form a cyclic compound, in the production of which one molecular proportion of the amide reacts with one of the aldehyde. The substance gives no coloration with ferric chloride, indicating that the hydroxyl group of the salicylamide has participated in the condensation, and it yields an acetyl derivative which is decomposed by concentrated sulphuric acid with the formation of *N*-acetylsalicylamide. It is accordingly regarded as a cyclic compound of the oxazine group, namely, *2-phenyl-*1 : 3-*benzoxazone*,  $C_6H_4\left<\begin{array}{l}CO\cdot NH\\ O-CHPh\end{array}\right.$; an alternative tautomeric formula is of course also possible. It crystallises from alcohol in silky needles which melt at 169°. On prolonged boiling with water it is gradually decomposed into its constituents; this decomposition is very readily effected by alkalis, less readily by dilute mineral acids. Heated with aniline, benzylideneaniline and salicylamide are formed. The *acetyl* derivative crystallises from alcohol in slender prisms which melt at 88°. It is decomposed into its constituents by heating with dilute alkalis or with dilute mineral acids, and when heated with aniline forms acetanilide, benzylideneaniline, and salicylamide.

2-p-*Methoxyphenyl*-1 : 3-*benzoxazone*,  $C_6H_4\left<\begin{array}{l}CO\cdot NH\\ O-CH\cdot C_6H_4\cdot OMe\end{array}\right.$, is prepared by the condensation of salicylamide with anisaldehyde. It melts at 166—167° and forms an *acetyl* derivative which melts at 91°, and resembles the corresponding phenyl compound in its chemical behaviour.

*Benzylidene*bis-o-*methoxybenzamide*, $C_6H_5\cdot CH\colon(NH\cdot CO\cdot C_6H_4\cdot OMe)_2$, prepared by the condensation of *o*-methoxybenzamide with benzaldehyde, is much more stable towards alkali than the above cyclic compounds, and is not acetylated by heating with acetic anhydride. It crystallises from alcohol in fine needles melting at 156°.

37. "The condensation of diethylmalonamide with aldehydes." By Harry Burrows and Charles Alexander Keane.

Diethylmalonamide, when heated with benzaldehyde in presence of hydrochloric acid, condenses similarly to salicylamide (compare Keane and Nicholls, preceding abstract) to form a cyclic compound of the pyrimidine group: 4:6-*diketo-2-phenyl-*5:5-*diethylhexahydropyrimidine*,  $CHPh<\begin{matrix}NH\cdot CO\\NH\cdot CO\end{matrix}>CEt_2$. It crystallises in prisms which melt at 262°; it is stable towards dilute mineral acids, but is decomposed by boiling with sodium hydroxide solution. Heated with acetic anhydride it forms a *diacetyl* derivative which melts at 147° and which is decomposed with elimination of the acetyl groups by treatment with concentrated sulphuric acid.

The corresponding *cinnamyl* compound melts at 241° and also forms a *diacetyl* derivative which melts at 125°.

Chloral-diethylmalonamide, $CEt_2(CO\cdot NH_2)_2,CCl_3\cdot CHO$, is prepared by condensing molecular proportions of diethylmalonamide and chloral hydrate with hydrochloric acid. It melts at 178° and is stable towards boiling water or hot dilute hydrochloric acid.

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Friday, March 22nd, 1907** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets must be received not later than Friday, March 15th next.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, made payable to "Mr. S. E. Carr" and addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

At the next Ordinary Meeting on **Thursday**, February **21st**, 1907, there will be a ballot for the election of Fellows and the following papers will be communicated :

"The constitution of oxyazo-compounds." By W. B. Tuck.

"The influence of solvents on the rotation of optically active compounds. Part IX. A new general method for studying intramolecular change." By T. S. Patterson and A. McMillan.

"The reduction products of *o*- and *p*-dimethoxybenzoin." By J. C. Irvine and A. M. Moodie.

"Replacement of halogens by hydroxyl. I. The hydrolytic decomposition of hydrogen and sodium monochloroacetates by water and by alkali, and the influence of neutral salts on the reaction velocities." By G. Senter.

"The reaction of ammonium salts with the constituents of the soil." By A. D. Hall and C. T. Gimingham.

"Constituents of natural indigo. Part II. Indigo-yellow." By A. G. Perkin.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, February 21st, 1907.

Allen, Alfred Frederick,
35, Purrett Road, Plumstead, Woolwich, S.E.

Student. Three years' training in Chem. Lab. of University College, London, for the B.Sc. Exam. (Lond.). Honours in Chemistry. B.Sc. Hons. 1906.

W. Ramsay. N. T. M. Wilsmore.
J. Norman Collie. Edward C. Cyril Baly.
Samuel Smiles.

Bagley, George,
Wellington, New Zealand.

Chemist. Works manager for Young's Chemical Works, Wellington, New Zealand, and formerly for the Metropolitan Chemical Co., Wellington, N. Zealand. Joint author with Professor Easterfield of paper on "The Constitution of Abietic Acid," *Trans.*, 1904.

Thomas H. Easterfield. P. W. Robertson.
B. C. Aston. *J. S. Maclaurin.*
Percy B. Phipson.

Baker, Frank, B.Sc.,
St. John's School, Eton.

Research Student at University College. Three years Student in the Chemical Laboratory, University College, London.

William Ramsay. Samuel Smiles.
J. Norman Collie. Edward C. Cyril Baly.
N. T. M. Wilsmore.

Bassett, Henry, jun.,

London (26, Belitha Villas, Barnsbury, N.).

Demonstrator and Assistant Lecturer, University of Liverpool. B.Sc. (Lond.); Ph.D. (Munich); D. ès Sc. (Nancy); F.I.C. 1851 Exhibition Scholar, 1903—1905. Have published papers alone or in conjunction with others in *Trans. Chem. Soc.*; *Berichte*; *Bull. Soc. Chim.*; *Journal de chemie physique*, &c.

J. Campbell Brown.
F. G. Donnan.
William Ramsay.
A. W. Titherley.
J. Norman Collie.

Benton, Frank Stanley,

"Hurstead," Reigate.

Assistant to John Heron, Esq., F.I.C., F.C.S. Certificated Student of the City and Guilds Technical College, Finsbury.

R. Meldola.
John Heron.
John Castell-Evans.
John C. Umney.
David Howard.

Berry, Leslie Hamilton,

"Penshurst," Croham Park Avenue, S. Croydon.

Lecturer and Demonstrator, Chemical Dept., Finsbury Technical Coll., B.Sc. (Hons.) London. Associate of the Institute of Chemistry.

R. Meldola.
Lester Reed.
John Castell-Evans.
Samuel Smiles.
Edward W. Bealey.

Cart, John Trevor,

4, Simonside Terrace, Heaton, Newcastle-on-Tyne.

Chemist. B.Sc. (Lond.); A.I.C.; Pharmaceutical Chemist. Jacob Bell Scholar, 1902—03. Jun. demonstrator Practical Chemistry in Pharm. Soc. School, 1903—04, and demonstrator in Pharmaceutics, 1904—05. Chemist with Messrs. Hopkin and Williams, 1905—06. Now with Messrs. C. A. Parsons & Co., Heaton Works.

Arthur W. Crossley.
W. Palmer Wynne.
Herbert Jackson.
Harold Deane.
C. T. Bennett.

Christie, John,

Eton College, Windsor.

Schoolmaster. B.A., Natural Sciences Tripos, Pt. I., 1905. Studied Chemistry for 4 years at Cambridge.

H. J. H. Fenton.
H. O. Jones.
W. J. Sell.
F. W. Dootson.
F. E. E. Lamplough.

Clough, George William,

29, Oseney Crescent, N.W.

Lecturer, Birkbeck College, E.C. B.Sc. (Birm.). Author of paper entitled "Condensation of Benzophenone Chloride with α- and β-Naphthols" (*Trans.,* 1906, 89, 771).

Percy F. Frankland. Alex. McKenzie.
C. F. Baker. Henry Wren.
G. Druce Lander.

Cook, Taylor,

20, Shiddridge Street, Parson's Green, S.W.

Student at Royal College of Science, 1903—06; B.Sc., A.R.C.S. At present engaged in teaching at the Royal College of Science.

William A. Tilden. G. T. Morgan.
M. O. Forster. James C. Philip.
H. E. Fierz.

Dall, Colin Ernest,

"Maisonette," Maybury Road, Woking.

Student. Three years at University College, London. B.Sc., London, 1906. Hons. Chemistry.

William Ramsay. Edward C. Cyril Baly.
J. Norman Collie. Samuel Smiles.
N. T. M. Wilsmore.

Davidson, Francis,

Dover Place, Ashford, Kent.

Brewer and Maltster. Well up in General and Analytical Chemistry, able to do all analyses required in brewing and malting.

A. J. Murphy. *B. E. R. Newlands.*
Basil P. Wigan. *Arthur R. Ling.*
Basil Wm. Valentin. *Geo. Patterson.*
Thomas FitzGibbon.

Denham, William Smith,

2, Kelvinside Terrace North, Glasgow.

Lecturer in Chemistry, Glasgow and West of Scotland Technical College. Fellow of the Institute of Chemistry; B.Sc. (Lond.).

G. G. Henderson. T. S. Patterson.
Thomas Gray. Charles E. Fawsitt.
Alexander Davidson, jr.

Dikshit, Mohan Nath Kedarnath,

21, Burlington Road, Bayswater, London, W.

Medical Practitioner. Graduate of the Bombay University (Medical Faculty). Lord Reay Lecturer, Grant Medical College, Bombay.

Tutor in Physiology (Experimental and Chemical), G. M. College, Bombay. Veine Analyser to the Techno-chemical Laboratory, Bombay.

John Muter. Geo. A. Turner.
A. H. M. Muter. *James W. Epps.*
J. H. B. Wigginton.

Eastaugh, Frederick Alldis,

Forty Hill, Enfield, then Sydney University, New South Wales.

Metallurgist, engaged as Teacher. First Class Associateship of the Royal School of Mines in Metallurgy. First Class Inter. B.Sc., London. Formerly assistant to Mr. G. T. Holloway, Chemist to Edison Ore Milling Syndicate. Demonstrator at R. S. M., and appointed same in Assaying and Chemistry at Sydney University.

W. Gowland. William A. Tilden.
S. Herbert Cox. James C. Philip.
G. T. Morgan.

Farmer, John Edwin,

"Blelsoe," New Road, Mitcham Junction.

Analyst to the Sewage Farms Committees. Corporation of Croydon. Sixteen years' experience of Sewage Purification, over eight years of which in the above. Member of the Society of Chemical Industry, also Member of the Royal Sanitary Institute.

J. Carter Bell. A. W. Cowburn.
W. J. Dibdin. James Ashton.
Frank Scudder.

Fowles, George,

28, Weltje Road, Hammersmith, W.

Science Master. Assistant Chemistry Master, Latymer Upper School, Hammersmith, W., since 1902. Intermediate Science (London Univ.), Honours in Chemistry; reading in Honours Chemistry for final B.Sc.

Frank E. Weston. W. H. Ratcliffe.
H. R. Ellis. *C. T. Bennett.*
Geo. W. T. Horrod.

Foxell, Edward William Lanchester,

22, Grand Avenue, Muswell Hill, N.

Chemistry Student, University College, London. Two years at University College, London. B.Sc. (London). Demonstrator in Chemistry, Univ. Coll., London.

William Ramsay. Edward C. Cyril Baly.
J. Norman Collie. N. T. M. Wilsmore.
Samuel Smiles.

Fryer, Percival John,

27, Minster Road, Cricklewood, N.W.

Analytical Chemist. For 4½ years Assistant to Mr. A. W. Stokes, F.I.C., F.C.S., Public Analyst. For last 2½ years, Analytical Chemist to the Chiswick Soap and Polish Co., W.

Alf. W. Stokes. Frank E. Weston.
Cecil Revis. J. L. White.
Henry R. Ellis.

Gibson, William Howieson,

48, Lady Margaret Road, Kentish Town, N.W.

Research Student in Chemistry. Three years a Student at University College, London. Third Class Honours in Physics, Intermediate Science, London. First Class Honours in Chemistry, B.Sc., London, 1906. Demonstrator at University College, London.

William Ramsay. Samuel Smiles.
J. Norman Collie. N. T. M. Wilsmore.
R. W. Gray.

Godden, William,

Station Road (East), Canterbury.

Two years assisting in teaching at Simon Langton Schools, Canterbury. Three years as Student at the Royal College of Science. A.R.C.Sc.; B.Sc. (Lond.); First Honrs. At present doing Research work at the Royal College of Science.

William A. Tilden. G. T. Morgan.
M. O. Forster. Chapman Jones.
James C. Philip. H. E. Fierz.

Green, William Heber,

The University of Melbourne.

Lecturer and Demonstrator in Chemistry. B.Sc. and Dixson Scholar in March, 1898; Kernot Scholar in 1899. D.Sc. in April, 1905; Demonstrator in Chemical Laboratory since April, 1898. Papers: "The Oxidation of Cane-sugar by Aqueous Solutions of Potassium Permanganate," *Proc. Roy. Soc.*, Victoria (1899), Vol. XI., "Notes on the Iceland Star Method for the Standardization of Hydrochloric Acid," *Chem. News* (1903), 87, pp. 5—8.

Orme Masson. Fred. W. Steel.
Charles Tilburn. D. Avery.
Bertram D. Steele.

Grieb, Christopher Maurice Walter,

33, Torrington Park, North Finchley, London, N.

Research Student in Chemistry. Three years a Student in the

Chemical Laboratories at University College, London. Second Class Honours in Chemistry, B.Sc. (London), 1906. Final A.I.C. in Mineral Chemistry, Jan. 1907 (at first entry).

William Ramsay.	N. T. M. Wilsmore.
J. Norman Collie.	R. W. Gray.
Samuel Smiles.	Edward C. Cyril Baly.

Higham, Richard,

133, Mauldeth Road, Withington, Manchester.

Principal, Plymouth Grove Municipal Sch., Manchester. First Class Certifs. Adv. Theor. and Pract. Chemistry; Lecturer for ten years in Ely. and Adv. Theor. and Pract. Inorg. Chem. Attended Honours Courses in above subjects. Special Tutor in Chemistry and Mathematics for Matric., Inter., and Final Exams. in Science. First Class Trained Certificated Master, &c.

Alfred Nixon.	John Allan.
R. L. Taylor.	Jas. Grant.

F. S. Sinnatt.

Hooton, William Marrs,

Repton, Burton-on-Trent.

Chemistry Master, Repton School. M.A. (Oxon., 1st Class Honours, Natural Science). Has carried on research work under Mr. A. G. Vernon Harcourt (on Nitrogen Peroxide) and under Prof. Campbell Brown (on Margaric Acid). M.Sc. (L'pool Univ., 1st Class Honours, Chemistry). Assoc. Institute of Chemistry. Late Head of the Science Dept., Middlesbrough High School and Technical School, 1902—6. Chemistry Master, Repton School.

A. Vernon Harcourt.	J. Campbell Brown.
A. W. Titherley.	W. Collingwood Williams.

Andrea Angel.

Hoyten, William James,

37, Ravelstoke Road, Wimbledon Park, London, S.W.

Surgeon. M.R.C.S., Eng.; F.R.C.P., Lond.; F.R.G.S., F.Z.S. Medallist and 1st Class Certif. Honours Owen's Coll., Practical Chemistry. Serumtherapy of Carcinoma (orig. research), *British Med. Journal.* Action of the Thyroid Gland (orig. research), *British Med. Journal.*

E. A. Fasnacht.	*Chas. Turner.*
Joseph Gaskell.	*Charles Dreyfus.*
William McCleary.	*Ernest Bentz.*

Hughes, Francis Townshend Cunynghame,
Calcutta or Bombay, India.

Major, Indian Army. Qualified in Chemistry and Metallurgy at the Royal College of Science, and in Assaying at the Royal Mint according to regulations laid down for Indian Assay Dept. At present, holds appointment of Dept. Assay Master, Calcutta Mint.

William A. Tilden.
G. T. Morgan.
W. H. Merrett.
Chapman Jones.
G. S. Newth.

Hussey, Arthur Vivian,
"Banthwaite," Belmont, Sutton, Surrey.

Research Student, Central Technical College; Inter. B.Sc. (Lond.), Hons. in Chemistry; A.C.G.I.

Henry E. Armstrong.
Gerald T. Moody.
T. Martin Lowry.
William A. Davis.
William Robertson.
Edward Horton.

Jackson, Ernest Wilfrid,
65, Douglas Terrace, Middlesbro'.

Analytical Chemist. Premium pupil with J. E. Stead, Esq., F.R.S., &c., 1896—1900, in whose laboratory have occupied the position of chief assistant chemist since 1900. (Honours, City and Guilds' Exam., Iron and Steel.) Teacher of Iron and Steel Manufacture in Technical College.

J. E. Stead.
H. Frankland.
C. H. Ridsdale.
E. H. Saniter.
J. Archyll Jones,
J. W. Patterson.

Jackson, Victor George,
21, Frankfurt Road, Herne Hill, S.E.

Analytical Chemist. Engaged in analytical chemistry.

H. B. Baker.
A. H. Coote.
Frank E. King.
A. Angel.
James Leicester.

Jennings, Sidney James,
367, Queen's Road, New Cross.

Teacher. Spent three years (Sept., 1901 to Sept., 1904) in University College, London (Analytical), Laboratory, under Sir William Ramsay. Passed B.Sc. (London) in 1904. (Chemistry was one of the subjects.)

William Ramsay.
Edward C. Cyril Baly.
N. T. M. Wilsmore.
E. Barrett.
Francis W. Storey.

King, Albert Theodore,

Church Hill, Horsell, Woking.

Student. Three years at University College, London; B.Sc. Lond.; First Class Honours in Chemistry.

William Ramsay. Edward C. Cyril Baly.
J. Norman Collie. Samuel Smiles.
N. T. M. Wilsmore.

Lunan, George,

50, Garscube Terrace, Murrayfield, Edinburgh.

Pharmaceutical Chemist, 20, Queensferry St., Edinburgh. Formerly Examiner to Pharmaceutical Society of Great Britain. Papers on following subjects: "Note on Commercial Hypophosphorous Acid," *P. J.*, vol. xvii., fol. 773, 3rd series, 1886–87; "Hypophosphorous Acid," *P. J.*, vol. xviii., fol. 872, 3rd series, 1887–88; "Syrupus Ferri Hypophosphites," *P. J.*, vol. xviii., fol. 872, 3rd series, 1887–88; "Purity of Commercial Samples of Dried Sulphate of Iron," *P. J.*, vol. xix., fol. 226, 3rd series, 1888–89; "Tinctura Quininæ Ammoniata," *P. J.*, vol. xix., fol. 436, 3rd series, 1888–90; "Granular Effervescent Preparations," *P. J.* [4], vol. viii., p. 141, 1899; "Glycerinum Acidi Borici," *P. J.* [4], vol. xviii., p. 7, 1904; Report on "Effervescent Granules" for the Pharmacopœia Committee of the General Medical Council, *P. J.* [4], vol. xxiii., fol. 665 *et. seq.*, 1906.

Leonard Dobbin. Peter MacEwan.
M. Carteighe. *Alex Crum Brown.*
Walter Hills. *Charles A. Hill.*

Martin, Joseph,

Coopers' Company's School, Bow.

Teacher of Chemistry, Science Department, Coopers' Company's School, Bow. Three years Student in Armstrong College, Newcastle. B.Sc. degree (Durham University) in Chemistry. Assistant in Chemistry Department, Coopers' Company's School, Bow.

P. Phillips Bedson. S. Hoare Collins.
F. C. Garrett. Harold E. Richardson.
Clarence Smith.

Matthews, Charles Pask,

6, Fortess Road, London, N.W.

Science Master. Bachelor of Science Honours, University of London. Works Chemist, Messrs. Hopkin & Williams, Hatton Garden, E.C.

Late Assistant Science Master, Technical Science and Art Schools, Tiverton, Devon.

A. E. Thomas. Horace Finnemore.
John C. Umney. W. H. C. Jemmett.
W. H. Mills. A. E. Dunstan.

Murgatroyd, Louis,

1, Carlton Drive, Heaton, Bradford.

Analytical Chemist. Practised for two years as Analytical Chemist (Sutcliffe and Murgatroyd). Pupil to Dr. Petraczek (Analytical and Consulting Chemist, Bradford) for two years. Student for two years in the Chemistry Department, Yorkshire College. Studied under Dr. Hieppe in the laboratories of Meister, Lucius, & Brüning, Hœchst, a/M.

C. Rawson. *Joshua Knowles.*
Ad. Liebmann. *William E. Kay.*
Thorpe Whitaker. *W. H. Pennington.*
William G. White.

Oberländer, Otto, Ph.D.,

Chamber of Commerce Buildings, Oxford Court, Cannon Street, E.C.

Consulting Chemist. Student at Heidelberg University and Karlsruhe (Polytechnicum). Assistant to Professor Noelting Mülhausen (Alsatia). Manufacturing Chemist in Bury, near Manchester.

J. C. Cain. Arthur G. Green.
Ad. Liebmann. J. Tcherniac.
R. W. Sindall.

Remfry, Frederic George Percy, B.A. (Camb.), D.Sc. (Geneva),

Sunnymead, Tenby, S. Wales.

Research Student at University of Manchester, now Chemist in Research Laboratory, Messrs. Burroughs, Wellcome & Co. Joint author of following papers: "Formation and Reactions of Imino-compounds," *Jour. Chem. Soc.*, 1904. "Uber fünf Quinaldinderivate," *Ber.*, 1905.

Harold B. Dixon. J. F. Thorpe.
W. H. Perkin, jun. H. A. D. Jowett.
Frank Lee Pyman.

Robertson, Robert,

9, Sewardstone Road, Waltham Abbey, Essex.

Research Chemist. M.A.; D.Sc. of St. Andrew's University.

Fellow of the Institute of Chemistry. In charge of the Laboratory, Royal Gunpowder Factory. Has prosecuted researches in explosives, of which are published: "On the Will Test for Nitrocellulose," *J.S.C.I.*, 1902, p. 819, and "On Purifying and Stabilising Guncotton," *J.S.C.I.*, 1906, p. 624.

Horatio Ballantyne. W. Rintoul.
W. T. Thomson. Sydney S. Napper.
William Barbour.

Salway, Arthur Henry,

15, Palmerston Road, Forest Gate, E.

Research Chemist. Ph.D. (Leipzig), B.Sc. (Lond.).

Published in the Transactions of the Chemical Society a conjoint paper with F. S. Kipping on "The Arrangement in Space of the Groups Combined with the Tervalent Nitrogen Atom."

Frederick B. Power. M. Barrowcliff.
A. C. O. Hann. Frank Tutin.
Harold Rogerson.

Schlienger, Charles,

Acadia House, 273, Camden Road, London, N.

Assistant Lecturer. Chemical Department, East Ham Technical College. B.Sc. (London). Late Demonstrator in the Chemical Dept., Birkbeck College, London, E.C.

A. E. Dunstan. W. H. Barker.
W. T. Clough. Alex. McKenzie.
H. Wren.

Sewell, William George,

27, Park Road, Wandsworth Common, S.W.

Science Teacher. Bachelor of Science (London). I have studied Chemistry for 15 years, and would like to keep in touch with the latest researches. I have done some research, and am about to devote the whole of my leisure in this direction.

A. Greeves. H. R. Ellis.
Frank E. Weston. Léon E. Walling.
W. H. Ratcliffe.

Shepheard, Frederick George,

9, Leinster Road, Rathmines, Co. Dublin.

Chemist. B.Sc. First Class Honours in Chemistry, University of London. Associate of the Royal College of Science, London. Engaged in research in the laboratory of Messrs. Guinness and Co. Joint author with Prof. Tilden of two papers in the *Transactions*.

William A. Tilden.
M. O. Forster.
G. T. Morgan.
James C. Philip.
G. S. Newth.

Smith, Robert Low,

56, Genesta Road, Plumstead, S.E.

Analytical Chemist. Training in Chemistry at King's College, 1902—04. Now occupying position as chemist of Johnson and Phillips' Electrical Engineering and Cable Manufacturing Works.

W. H. Deering.
Oliver Trigger.
R. J. Redding.
H. Russell Pitt.
J. C. Aylan.

Templeton, William Sandilands, M.A., B.Sc.,

Colombo, Ceylon (after 20th October, 1906).

Professor of Physics at the Medical and Technical Colleges, Colombo, Ceylon (recently appointed). Studied Chemistry at Glasgow University under Prof. Ferguson and W. R. Lang, at Glasgow and West of Scotland Technical College under Prof. G. G. Henderson and M. Parker, and at the Royal College of Science, S. Kensington, under Prof. Tilden and Dr. M. O. Forster. Was a teacher of Chemistry for two years in Allan Glen's School, Glasgow. Desires to keep in touch with the latest developments of Chemical Science in view of his having occasionally to undertake the duties of the Prof. of Chemistry at Colombo.

F. E. Matthews.
John Ferguson.
A. Campion.
F. W. Harbord.
M. O. Forster.

Thomas, Richard Noel Garrod,

Balliol College, Oxford.

Bachelor of Arts. Demonstrator in Chemistry, Balliol Coll., Oxon. Part author of a paper on "Spontaneous Crystallisation" (*J.C.S.*, July, 1906).

Harold Hartley.
D. H. Nagel.
N. V. Sidgwick.
A. F. Walden.
W. W. Fisher.

Toch, Maximilian,

261, West 71 Street, New York City.

Chief Chemist and member of firm of Toch Brothers, Colour and Varnish Mfrs., N.Y. Graduate and Post Graduate, New York University. Graduate Chemical Department, Cooper Institute.

Author of "Chemistry of Mixed Paints," "Permanent Protection of Iron and Steel," "Composition of Paints and Raw Materials," &c.

Chas. Baskerville.
F. P. Venable.
James Lewis Howe.
Leo F. Guttmann.
Peter T. Austen.
William Ramsay.
Chas. H. Herty.

Twiney, William George,

St. Joseph's College, Colombo, Ceylon.

Science Master. B.Sc., London; Third Class Honours Chemistry. Two years Science Master, Dorchester Grammar School. Science Master, St. Joseph's College, Colombo.

E. K. Hanson.
John W. Taylor.
J. W. Dodgson.
J. K. H. Inglis.
A. E. Bellars.

Watkins, Charles Rowlatt,

Aldenham School, Elstree, Herts.

A Science Master at Aldenham, now Assistant Collector in Imperial Customs Service, Madras, India. Formerly Scholar of Emmanuel Coll., Cambridge. Natural Science, Tripos I. and II.

G. D. Liveing.
Charles T. Heycock.
W. J. Sell.
F. W. Dootson.
T. B. Wood.
H. O. Jones.

Wight, Robert Burt,

3, Clarendon Terrace, Linthorpe Road, Middlesbrough.

Teacher of Science. M.A., Cantab (Hons., Nat. Sci. Tripos), Inter. B.Sc. (Lond.). Head of Science Department, Middlesbrough High School and Middlesbrough Technical Classes, late Head of Science Department, Oldham Hulme Grammar School.

J. E. Stead.
J. Archyll Jones.
J. W. Patterson.
H. Frankland.
C. H. Ridsdale.
E. H. Saniter.

Williams, William Henry,

Government Education Department, Hong Kong.

1903—5, Supervisor Anglo-Chinese Schools; 1905—present, Headmaster Victoria School (Secondary School for Boys). Organizing Secretary to Govt. for Tech. Instruction. Student: three years Inorg. Chem.; two years Organic Chem., Municipal Tech. School, Birmingham. Board of Educ. Certifs., 1st Lond. Matric. (Chemistry). Author of "Experiments in Hygiene," a teacher's handbook for instruction in

Tropical Diseases and Sanitary Science, printed and published by the Hong Kong Government. Asst. Lec. (1900—1), Munic. Tech. Day School, B'gham; two years Lecturer in Chemistry and Physics, Institute of Engineers, Hong Kong.

Lionel M. Jones.	*T. Slater Price.*
T. Francis Rutter.	*Douglas F. Twiss.*
W. A. S. Calder.	*J. A. Harrison.*

Wolff, Mark Arthur,

6, Hanover Terrace, Holland Park, W.

Assayer, Analytical Chemist, and Mining Engineer. For two years Chief Assayer and Advising Chemist to the Wei-Hai-Wei Gold Mining Company of Shanghai, China (July, 1904—September, 1906).

W. H. Merrett.	J. W. Shepherd.
E. O. Courtman.	*G. T. Morgan.*

J. C. Philip.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 321.

Thursday, February 21st, 1907, at 8.30 p.m., Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. T. S. Patterson and E. G. Streimer were formally admitted Fellows of the Society.

The President announced that the Society had incurred a further loss by the death of Professor Henri Moissan, which occurred on February 20th, in Paris; the late Professor Moissan was elected an Honorary and Foreign Fellow Member of the Society on January 20th, 1898.

On behalf of the Executive Committee of the Coal Tar Colour Jubilee Celebration, it was stated by the Chairman, Professor R. Meldola, that the Council of the Society had that afternoon accepted the marble bust of Sir William Perkin, which was to be placed in the rooms of the Chemical Society according to the decision of the public meeting at which the celebration was inaugurated.

It was further stated that the Council had received and acknowledged, in the name of the Society, an important addition to the Research Fund in the form of a contribution of £1000 from the Worshipful Company of Goldsmiths.

Certificates were read for the first time in favour of Messrs.:

William Robert Ball, B.Sc., 48, Cambridge Road, Thornaby-on-Tees.
Alexander Thomas Cameron, M.A., B.Sc., Burtonhill, Malmesbury.

Geoffrey Dodleston Hope, B.Sc., Ph.D., Heath Heys, Oxton.
The Hon. Raymond Egerton Hubbard, Addington Manor, Winslow.
Herbert Brooke Perven Humphries, B.Sc., 117, Avenell Road, Highbury, N.
James McConnan, M.Sc., Ph.D., Danehurst, Greenbank Drive, Liverpool.
Percy Joseph Rhodes, Bridge House, Church.
Sydney William Smith, B.Sc., 76, Norroy Road, Putney, S.W.
Nicholas Tarr, Lucton School, Herefordshire.
William Scott Tebb, M.A., M.D., Sandfield, Putney Heath Lane, S.W.

It was announced that the following changes in the Officers and Council were proposed by the Council.

As President: Sir William Ramsay, K.C.B., F.R.S.; *vice*, Prof. R. Meldola, F.R.S.

As Foreign Secretary: Dr. Horace T. Brown, F.R.S.; *vice*, Sir W. Ramsay.

As Vice-Presidents: Prof. J. J. Dobbie, F.R.S., and Sir Alexander Pedler, F.R.S.; *vice*, Dr. H. T. Brown, F.R.S., and Prof. H. B. Dixon, F.R.S.

As Ordinary Members of Council: Mr. G. T. Beilby, Dr. W. R. Hodgkinson, Mr. E. Grant Hooper, and Dr. H. R. Le Sueur; *vice*, Prof. W. Gowland, Mr. A. D. Hall, Dr. A. Lapworth, and Mr. J. E. Marsh, F.R.S.

Mr. E. Grant Hooper, Dr. H. F. Morley, and Dr. H. R. Le Sueur were elected Auditors to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were declared duly elected:

Alfred Frederick Allen B.Sc.
George Bagley.
Frank Baker, B.Sc.
Henry Bassett, jun., B.Sc., Ph.D.
Frank Stanley Benton.
Leslie Hamilton Berry, B.Sc.
John Trevor Cart, B.Sc.
John Christie, B.A.
George William Clough, B.Sc.
Taylor Cook.
Colin Ernest Dall, B.Sc.
Francis Davidson.
William Smith Denham, B.Sc.
Mohan Nath Kedarnath Dikshit.
Frederick Alldis Eastaugh.
John Edwin Farmer.
George Fowles.
Edward William Lanchester Foxell, B.Sc.
Percival John Fryer.
William Howieson Gibson, B.Sc.
William Godden, B.Sc.
William Heber Green, D.Sc.
Christopher Maurice Walter Grieb, B.Sc.
Richard Higham.

William Marrs Hooton, M.A., M.Sc.
William James Hoyten, M.R.C.S. F.R.C.P.
Francis Townshend Cunynghame Hughes.
Arthur Vivian Hussey.
Ernest Wilfrid Jackson.
Victor George Jackson.
Sidney James Jennings, B.Sc.
Albert Theodore King, B.Sc.
George Lunan.
Joseph Martin, B.Sc.
Charles Pask Matthews, B.Sc.
Louis Murgatroyd.
Otto Oberländer, Ph.D.
Frederic George Percy Remfry, B.A., D.Sc.
Robert Robertson, M.A , D.Sc.
Arthur Henry Salway, Ph.D., B.Sc.
Charles Schlienger, B.Sc.
William George Sewell, B.Sc.
Frederick George Shepheard, B.Sc.
Robert Low Smith.
William Sandilands Templeton, M.A., B.Sc.
Richard Noel Garrod Thomas, B.A.
Maximilian Toch.
William George Twiney, B.Sc.
Charles Rowlatt Watkins, B.A.
Robert Burt Wight, M.A., B.Sc.
William Henry Williams.
Mark Arthur Wolff.

The Council has ordered the following report to be printed in the Proceedings of the Society:

RECOMMENDATIONS AS TO THE NOMENCLATURE OF THE PROTEINS.

It is well known that much confusion arises at the present time from the lack of any understanding, either here or abroad, as to the exact sense in which the various names applied to proteins (Proteinstoffe, Eiweisskörper, Albuminoids) and their derivatives shall be used. No little difficulty is created by the use of a term in different senses, as well as ambiguity of meaning in some cases. It appeared desirable, therefore, to lay down rules for the guidance of students and workers, at all events in this country, which would tend to promote some degree of uniformity of usage. It was obviously desirable to retain existing terms as far as possible, especially as it was clear that the time is not yet come to coin strictly systematic names and that only provisional recommendations are desirable in the existing state of knowledge.

The following report is the outcome of a prolonged consideration of the subject by a number of chemists and physiologists. The original Committee was called into being by the Physiological Society; its members were nominated by the two societies. The report of the Committee was subjected to criticism, both by the Physiological Society and by the Publication Committee of the Chemical Society. At the instance of the latter body a number of chemists specially interested in the subject then took the matter into consideration in conjunction with a few representatives of the

Physiological Society; finally, a draft report embodying the conclusions arrived at was prepared by Drs. Halliburton and Hopkins, which was considered and amended at a meeting of the Publication Committee of the Chemical Society, at which the physiologists were present.

RECOMMENDATIONS.

I. The word Proteid—which is used in different senses in this country and in Germany—should be abolished.

II. The word Protein is recommended as the general name of the whole group of substances under consideration. It is at present so used both in America and Germany. It admits readily of the use of such derived words as protease and proteose. If used at all, the term Albuminoid should be regarded as a synonym of protein.

III. The sub-classes should be as follows:—

1. Protamines. These are simple members of the group. They are exemplified by substances like salmine and sturine which have been separated from fish-sperm.

2. Histones. These are more complex substances: this and the previous class probably pass gradually into one another. The class is exemplified by the histones separated by Kossel from blood corpuscles; precipitability by ammonia is one of their distinguishing features.

3. Albumins. These are proteins of which egg-albumin and serum-albumin may be taken as typical examples.

4. Globulins. These are proteins which differ from the albumins in solubility; they are more readily "salted out" of solution than the albumins. They are exemplified by serum-globulin and fibrinogen. The class should also include certain derivatives of globulins such as fibrin and myosin.

N.B.—The carbohydrate radicle separable in small quantities from many members of Classes 3 and 4 is probably not to be considered as a prosthetic group, as it is in the gluco-proteins (see below).

N.B.—It appeared advisable, especially from the teachers' standpoint, to introduce a general term to include proteins coagulable by heat (Classes 3 and 4); but a term likely to meet with general acceptance has not yet been suggested.

5. Sclero-proteins. This new word takes the place of the word

albuminoid in the limited sense in which the majority of physiologists have been accustomed to use it. It includes such substances as gelatin and keratin; the prefix indicates the skeletal origin and often insoluble nature of its members.

6. Phospho-proteins. This class includes such substances as vitellin and caseinogen with its derivative casein. The prefix nucleo- frequently used in relation to this class is incorrect and misleading.

7. Conjugated proteins. These are substances in which the protein molecule is united to a "prosthetic group." The principal subdivisions are:—

a. Nucleo-proteins.

b. Gluco-proteins (*e.g.*, mucin).

c. Chromo-proteins (*e.g.*, hæmoglobin).

8. Derivatives of Proteins. Of these the products of protein-hydrolysis (a term preferable to proteolysis *) are those which require special attention. These should be classified as follows:—

a. Meta-proteins. This term is suggested in place of albuminate (acid-albumin, alkali-albumin), which is objectionable because (1) these products are obtainable from both albumins and globulins, also (2) because the termination ate implies a salt.

b. Proteoses. This term includes albumose, globulose, gelatose, &c. The subdivision of these into proto-, hetero-, deutero-proteoses, &c., and the various modifications of Kühne's original classification have been considered; the whole subject is, however, at present too unsettled for any final nomenclature of these subdivisions to be proposed.

c. Peptones. This term should be restricted to the further products of hydrolysis which differ from the proteoses inasmuch as they cannot be salted out from solution and usually resemble them in giving the biuret test.

N.B.—It has been pointed out that certain vegetable products hitherto regarded as peptones do not give the biuret test. It does not appear possible to bring such exceptional substances into any general classification at present. The same difficulty in classify-ing arises in connexion with certain other vegetable proteins; for instance, those which like gliadin are soluble in alcohol.

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* Although mindful of the unfortunate fact that terms such as proteolysis fail to convey a meaning in harmony with that which is conveyed by the terms electrolysis and hydrolysis (on which they are moulded) of decomposition *by*, the Committee have not ventured to deal with the difficulty; they recognise, however, that the practice is one to be obviated, if possible (compare Armstrong, *Proc. Roy. Soc.*, 1904, **73**, 500).

d. Polypeptides. The majority of the polypeptides are synthetical substances. Some, however, have been separated from the products of protein-hydrolysis and it is therefore advisable to include them in the present classification. They are products of cleavage beyond the peptone stage and consist of two or more amino-acids in association; the majority of those hitherto prepared do not give the biuret test.

IV. The term caseinogen should be used for the principal protein in milk and casein for its derivative which is the result of the action of rennet.

V. The two principal proteins of the muscle plasma should be termed paramyosinogen and myosinogen; the term soluble myosin should take the place of v. Fürth's soluble myogen-fibrin; the term myosin should be restricted to the final product formed during *rigor mortis.*

Of the following papers, those marked * were read:

*38. "The constitution of hydroxyazo-compounds."
By William Bradshaw Tuck.

Several workers have proved that the ethers of all hydroxyazo-compounds and the benzoyl derivatives of the *p*-compounds possess the azo-structure, but that the benzoyl-*o*-hydroxyazo-compounds have the quinone-hydrazone configuration.

Chemical methods, however, have failed to produce a unanimous opinion with regard to the constitution of the free hydroxy-compounds.

As the absorption spectrum for azobenzene has been shown to be very different from that characteristic of quinones, several of the hydroxyazo-compounds were examined spectrographically.

The absorption spectra of the *p*-hydroxy-compounds agree extremely closely with those of their derivatives; further, hydrochloric acid produces the same very characteristic change in the spectra of the phenolic substances and their ethyl ethers. This proves that the constitution in the two cases is similar, that is, the free hydroxy-compounds are in the azo-form. The ethers of *o*-compounds also agree with the *p*-compounds, but the benzoyl derivatives are similar to benzoquinonebenzoylphenylhydrazone. The absorption spectra of all the azo derivatives examined confirm the hypothesis previously put forward for the colour of azobenzene (*Trans.*, 1906, **89**, 982).

DISCUSSION.

Dr. **Hewitt** agreed with Mr. Tuck that in the case of the *p*-hydroxyazo-compounds, the free substances, their ethers and esters were all of the azo-phenolic type, but was uncertain whether a solution of these substances in concentrated hydrochloric acid really contained much hydrochloride, since the bases being very weak, must have suffered considerable hydrolytic dissociation.

The contention that the *o*-hydroxyazo-compounds and their benzoyl derivatives corresponded to quinone-hydrazones was based apparently on the observation of Goldschmidt and Brubacher that acyl anilides result on complete reduction of the acyl derivatives of benzeneazo-*p*-cresol. This might, however, be equally well the result of a secondary reaction, since esters and primary amines normally react to give alcohols or phenols and acid amides. Against these equivocal results must be placed the positive evidence that on substitution these compounds behave as azophenols whether they belong to the para- or ortho-series.

The only other physical method hitherto adopted in the case of the hydroxyazo-compounds has been the application of cryoscopic determinations in non-hydroxylic solvents by Auwers and Orton, whose results indicate that the para-compounds are azophenols and give no positive result for the ortho-substances.

Goldschmidt himself abandoned the idea that the *o*-hydroxyazo-compounds were quinone-hydrazones, and his observation that the acylated compounds of both series reduce to hydrazo-compounds which are insoluble in alkali distinctly points to acylation, with respect to oxygen, having taken place.

Dr. **Lowry** said that Oddo's theory of "mesohydry" to which the author had referred was in many respects a reversion to Laar's theory of "tautomerism," since it postulated that a mobile hydrogen atom might be equally attached to oxygen and to nitrogen or carbon. If the hydrogen atom was capable under any conditions of settling in either of the alternative positions the phenomenon was not one of tautomerism, but a mere case of labile isomerism, which might become dynamic when the compound was liquefied with or without the addition of a catalyst. The separation of a single isomeride was a normal result of crystallisation, and, so far as he was aware, no genuine case of mesohydry or of tautomerism had yet been established. It was doubtful whether the hydrazo-compounds would prove to be an exception, although the possibility remained open that the crystals might, in certain cases, be isomorphous mixtures of two or more isomerides.

*39. "The influence of solvents on the rotation of optically active compounds. Part IX. A new general method for studying intramolecular change." By Thomas Stewart Patterson and Andrew McMillan.

The influence of benz*anti*aldoxime as a solvent on the rotation of ethyl tartrate was found to be very remarkable. A method of studying intramolecular change was described which had been applied in the cases of benzaldoxime, anisaldoxime, and ethyl phenylformylacetate.

*40. "Displacement of halogens by hydroxyl. I. The hydrolytic decomposition of hydrogen and sodium monochloroacetates by water and by alkali, and the influence of neutral salts on the reaction velocities." By George Senter.

By varying the initial concentration within fairly wide limits, it was shown that the hydrolytic decomposition of monochloroacetic acid by hot water according to the equation $CH_2Cl{\cdot}CO_2H + H_2O = OH{\cdot}CH_2{\cdot}CO_2H + HCl$ is strictly unimolecular up to $N/2$ solution; the reaction velocity is somewhat retarded by hydrochloric acid, but is not affected by sodium chloride. The conclusion is drawn that water and the undissociated acid are the reacting substances; if an intermediate compound is formed, it is the rate at which it breaks down into glycollic and hydrochloric acids which is measured.

The decomposition of sodium chloroacetate by water is strictly unimolecular in dilute solution, but in solutions more than 0·1 molar, the velocity increases more rapidly than the concentration. The reaction is retarded by neutral salts. Potassium and barium chloroacetates undergo decomposition at the same rate as the sodium salt.

The interaction of sodium chloroacetate and $N/10$ sodium hydroxide, according to the equation $CH_2Cl{\cdot}CO_2Na + NaOH = OH{\cdot}CH_2{\cdot}CO_2Na + NaCl$, proceeds only about ten times more rapidly than the corresponding change in aqueous solution under equivalent conditions. The reaction velocity in the presence of alkali is accelerated, and to the same extent, by such neutral salts as sodium chloride, sulphate, and nitrate in equivalent solution.

On the basis of these results and of the previous observations of Arrhenius, the hypothesis put forward by R. J. Caldwell (*Proc. Roy. Soc.*, 1906, *A*, **78**, 272), according to which the accelerating influence of neutral salts on reactions in which acids (and alkalis) exert a catalytic action is ascribed to the withdrawal of water by the salt and consequent concentration of the reacting substances, was criticised. It is considered that the effect in question is due to the action of the ions of the salt on H′ and OH′ ions.

DISCUSSION.

Dr. SENTER, replying to Dr. E. F. Armstrong, said that in his experiments, as in those of Arrhenius quoted in the paper, the ratio of alkali and acid respectively to water was constant, except for the slight differences in the amounts of water displaced by equivalent quantities of the neutral salts employed; that these differences did not amount to more than about 1 per cent. of the total volume, and were therefore negligible in comparison with the magnitude of the neutral salt effect. Moreover, it did not seem quite justifiable to conclude from the results of experiments with sucrose, the solution volume of which is large and remains unaltered on dilution, that solutions for comparison should in all cases be prepared by adding a definite weight of the solute to a definite weight or volume of the solvent (H. E. Armstrong, *Proc. Roy. Soc.*, 1906, **78**, *A*, 264); in particular, salts which in certain dilutions have a negative solution volume seem to present difficulties from this point of view.

*41. "The interaction of ammonium salts and the constituents of the soil." By Alfred Daniel Hall and Conrad Theodore Gimingham.

As it has been observed that an acid reaction develops in soil which has been repeatedly manured with ammonium salts, the authors have re-examined the action of ammonium salts on the chief constituents of soil. Solutions of various strengths, *N* to *N*/100, of ammonium sulphate, chloride, or other salt were shaken for twenty-four hours with silica, clay, calcium carbonate, and humus respectively, and the composition of the resulting solution was determined.

With silica, there is no action. With clay, a double decomposition takes place between the ammonium salt and zeolitic bodies in the clay, ammonium being withdrawn from solution and replaced by equivalent quantities of calcium, magnesium, and potassium. With varying strengths the reaction can be represented by the equation

$$\frac{(\text{Ammonium withdrawn from solution})^2}{\text{Ammonium remaining in solution}} = \text{K},$$

as long as the clay is in excess. If the clay is not in excess, it can only take up a fixed amount of ammonium whatever the strength of the solution. No acid reaction is produced, and there is no adsorption of the salt as a whole.

With calcium carbonate, the reaction does not proceed far, and the extent may be represented by an equation of similar form. With natural humus from various sources, the reaction is similar to that with clay; other bases, chiefly calcium, are displaced by ammonium; there is no development of acidity and no adsorption.

The acid reaction observed in the field is thus not due to inorganic causes; a biological origin has been found.

42. "The reduction products of *o*- and *p*-dimethoxybenzoin." By James Colquhoun Irvine and Agnes Marion Moodie.

o-Dimethoxybenzoin has been converted into the corresponding hydrobenzoin, and the latter compound, when reduced by Baeyer's process, gives *p*-dimethyltolane. This abnormal change has been shown to take place through the intermediate formation of *o*-dimethoxydiphenylethylene together with the corresponding ethane derivative.

As this result indicates that Baeyer's method of reduction may lead to erroneous conclusions in deducing the constitution of aromatic alkyloxy-compounds, a detailed study of the effect of the process on derivatives of anisoin has been made. It has been shown that both anisoin and its methyl ether are converted into deoxyanisoin when distilled with zinc dust in a current of carbon dioxide, and that the reduction is only complete when carried out in an atmosphere of hydrogen. The hydrocarbon finally obtained was stilbene.

In the course of the work a number of new derivatives of anisoin were prepared and examined.

43. "Constituents of natural indigo. Part II." By Arthur George Perkin.

Preliminary accounts of a portion of this work have previously appeared (*Proc.*, 1904, **20**, 172, and *ibid.*, 1906, **22**, 199). The kaempferol glucoside, kaempferitrin contained in the *Indigofera arrecta* is not hydrolysed by the insoluble indigo enzyme of Beyerinck (*Proc. K. Akad. Wetensch. Amsterdam*, 1900, 120), and its appearance in Java indigo is probably due to some extent to the employment of sulphuric acid at one stage of the manufacture. Numerous Java indigos have been examined, and all contained kaempferol, but in no case did this exceed 0·2 per cent. The leaves of the *Indigofera sumatrana* contain a trace of yellow colouring matter which probably consists of kaempferol.

44. "The velocity of hydrolysis of aliphatic amides." By James Codrington Crocker.

The rates of reaction of formamide, acetamide, propionamide, butyramide, *iso*butyramide, valeramide, capronamide with hydrochloric acid have been determined at from 40° to 80°. The determinations were carried out by measurement of the specific conductivity of the reacting mixture. Owing to the effect of the dissolved amide on the conductivity of the solution, the concentration could not be calculated directly from the specific conductivity. Synthetical mixtures were prepared representing definite stages of the reaction, and the variation of the specific conductivity of these with time was determined. By extrapolation to $t=0$ the initial specific conductivity was determined in each case. A concentration-conductivity curve was plotted which served to standardise the original conductivity-time curve. The reactions are bimolecular and follow the relation $K=\frac{1}{at}\left(\frac{1}{C}-\frac{1}{C^o}\right)$, where a is the degree of dissociation of the hydrochloric acid. The order of the relative reactivities is the same for each temperature; this order is formamide, propionamide, acetamide, *iso*butyramide, capronamide, butyramide, valeramide. The temperature coefficients of reactivity are very large, and the velocity constants closely follow the temperature law,

$$\log K = \log K_0 + B\left(\frac{1}{T'}-\frac{1}{T}\right).$$

A relation between the reactivity of the amides at constant temperature and the strength of the corresponding organic acids was indicated. The relative reactivities of the amides were also evaluated at "corresponding" temperatures and these values were shown to be nearly independent of temperature.

45. "The rusting of iron." By Wyndham Rowland Dunstan.

As a result of a long series of experiments (Dunstan, Jowett, and Goulding, *Trans.*, 1905, 87, 1548), it was shown that the rusting of iron can take place in the absence of carbonic acid, and that only iron, oxygen, and liquid water are necessary for rusting to occur. In order to elucidate the chemical change involved, and to explain the inhibiting effect on the rusting of iron produced by some substances and especially by alkalis and potassium dichromate, the working hypothesis was suggested that the formation of hydrogen peroxide is concerned in the change, rusting being prevented by those substances which are capable of decomposing the peroxide.

Recently, Dr. Gerald T. Moody (*Trans.*, 1906, **89**, 720) has published an account of experiments he has made which in his opinion prove that iron cannot rust in the absence of carbon dioxide. In the experiments recorded by the present author (*loc. cit.*) elaborate precautions were taken to ensure the absence of carbon dioxide, but it has been thought desirable to repeat the experiments made under somewhat different conditions by Dr. Moody. His conclusions have not, however, been confirmed; the results of experiments carried out in the manner described by him show that iron rusts freely in the absence of carbonic acid provided that iron, oxygen, and liquid water are brought together.

46. "Contributions to the chemistry of the rare earths. Part II." By Mario Esposito.

The methods of Muthmann and Böhm and Pattinson and Clarke for the preparation of ceria have been found to give a fairly pure product. Oxidation with potassium permanganate, according to Drossbach and Böhm's method, is probably the most rapid and satisfactory way of obtaining almost pure ceria.

Lanthana and old didymia can be separated by fractional crystallisation of the oxalates from strong nitric acid, but the process is not advantageous. Lanthana is best obtained by a modification of the method of Auer von Welsbach (fractional crystallisation of the double ammonium nitrates), which at the same time effects the separation of neodymia and praseodymia, the chief constituents of old didymia. After one hundred and ten fractionations, lanthana, praseodymia, and neodymia were obtained in a state of considerable purity.

47. "Derivatives of multivalent iodine. Part III. Action of heat on iodobenzene dichloride, and on the *m*- and *p*-nitro- and *p*-chloro-derivatives." By William Caldwell and Emil Alphonse Werner.

The authors have found that when iodobenzene dichloride is heated it undergoes sudden decomposition at 112—136° according to the rate of heating, the main change resulting in the formation of *p*-chloroiodobenzene. Only from 17 to 27 per cent. of the theoretical amount of chlorine is evolved in the free state. Rapid heating favours the formation of the substitution derivative. Whilst *o*- and *p*-iodonitrobenzene dichloride, when heated, decompose quantitatively in accordance with the equation,

$$C_6H_4(NO_2)\cdot ICl_2 = C_6H_4(NO_2)I + Cl_2,$$

the *m*-derivative loses from 72—73 per cent. of its chlorine in the free state, a substitution derivative being produced in corresponding proportion.

p-Chloroiodobenzene forms a dichloride, $C_6H_4Cl{\cdot}ICl_2$, which decomposes at 112°, the proportion of chlorine evolved in the free state amounting to 72 per cent. of the theoretical for the loss of two atoms. Thus the nitro-group in the ortho- and para-positions completely prevents the formation of substitution products, whilst chlorine in the para- has the same inhibiting effect as the nitro-group in the meta-position.

48. "The organic phosphorus compound formed by yeast-juice from soluble phosphates. Preliminary notice." By William John Young.

It has been shown by Harden and Young (*Proc.*, 1905, **21**, 189; *Proc. Roy. Soc.*, 1906, **77**, *B.*, 405) that when soluble phosphates are added to a fermenting mixture of yeast-juice and glucose a large increase in the rate of evolution of carbon dioxide is observed. This rate soon diminishes until a constant rate is attained, which is usually approximately equal to that of the original yeast-juice and glucose. It has been further shown that at the end of this period of increased fermentation, the phosphate has undergone some alteration, and is no longer present in a form precipitable by magnesium citrate mixture, and it was suggested that a combination with the glucose to form a phosphoric acid ester had taken place.

Experiments on the chemical nature of this compound have been carried out, and although not yet complete, it has been thought advisable to communicate a preliminary notice of the results so far obtained, in view of the publication of Iwanoff (*Zeit. physiol. Chem.*, 1907, **50**, 281), who appears to have obtained the same substance independently.

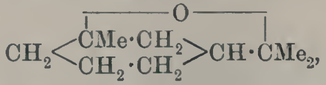
A lead salt of the compound was prepared from the fermentation mixture by first removing any free phosphate by magnesium nitrate and then adding lead nitrate. Analyses of two preparations, in which the carbon, hydrogen, lead, and phosphorus were determined, gave the empirical formula $C_3H_5O_6PPb$.

On suspending this salt in water and removing the lead with hydrogen sulphide, an acid solution is obtained which reduces Fehling's solution and gives Mohlisch's α-naphthol reaction. It is slightly dextrorotatory, and can be titrated with alkalis, using phenolphthalein as indicator, in a similar manner to phosphoric acid. On evaporating to dryness on the water-bath a charred mass is left which contains free phosphoric acid and has a strong odour of caramel, whilst on evaporation at the ordinary temperature in a vacuum over sulphuric acid a syrupy mass is left, which soon darkens in colour and decomposes.

When the solution is boiled for several hours the compound is slowly hydrolysed, phosphoric acid being set free, and a substance formed which reduces Fehling's solution more strongly than the acid itself, and rotates the plane of polarised light to the left. The nature of this reducing substance has not been exactly determined and experiments with this object are in progress.

49. "Experiments on the synthesis of the terpenes. Part X. Synthesis of carvestrene and its derivatives." By William Henry Perkin, jun., and George Tattersall.

Continuing their work on the synthesis of carvestrene (*Proc.*, 1906, **22**, 268), the authors have prepared m-*cineol*,



$$\mathrm{CH_2}{<}\begin{matrix}\mathrm{CMe\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}{>}\mathrm{CH\cdot CMe_2},$$

by the action of magnesium methyl iodide on ethyl *cyclo*hexanone-3-carboxylic acid, and the *cis*- and *trans*-modifications of m-*menthane*-1 : 8-*diol*, $\mathrm{CH_2}{<}\begin{matrix}\mathrm{CMe(OH)\cdot CH_2}\\ \mathrm{CH_2}\text{——}\mathrm{CH_2}\end{matrix}{>}\mathrm{CH\cdot CMe_2\cdot OH}$, have also been obtained.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Arrhenius, *Svante.* Immunochemie. Anwendungen der physikalischen Chemie auf die Lehre von den physiologischen Antikörpern. Uebersetzt von *Alexis* **Finkelstein.** pp. vii + 204. Leipzig 1907. (*Recd.* 20/2/07.)

Berthelot, *Marcellin.* Traité pratique l'analyse des gaz. pp. ix + 483. ill. Paris 1906. (*Recd.* 20/2/07.)

Calmette, *A.* Avec la collaboration de *E.* **Rolants**, *F.* **Constant**, *E.* **Boullanger**, *L.* **Massol**, et *A.* **Buisine.** Recherches sur l'épuration biologique et chimique des eaux d'égout. 2 vols. pp. v + 194, iv + 314. ill. Paris 1905—7. (*Recd.* 20/2/07.)

Donath, *Eduard*, und **Frenzel**, *Karl.* Die technische Ausnutzung des atmospärischen Stickstoffes. pp. v + 250. Leipzig 1907. (*Recd.* 20/2/07.)

Wiley, *Harvey W.* Principles and practice of agricultural analysis. A manual for the study of soils, fertilizers, and agricultural products. Second edition. Vol. I, Soils. pp. xii + 636. Easton, Pa. 1906. (*Recd.* 20/2/07.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Friday, March 22nd, 1907** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets must be received not later than Friday, March 15th next.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, made payable to "Mr. S. E. Carr" and addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

At the Annual General Meeting on Friday, March 22nd, the President will deliver an address entitled "The Position and Prospects of Chemical Research in Great Britain."

On Thursday, June 13th, Professor J. B. Farmer, F.R.S., will discourse on "Some Borderline Problems in Botany."

ERRATA.

1906. P. 197, line 6 from bottom, and p. 198, line 6 from top, *for* "acetophenyloxalic" *read* "benzoylpyruvic."

1907. P. 33, line 15 from top, *for* "3-dimethylphenonaphthoxazone" *read* "3-dimethylaminophenonaphthoxazone."

At the next Ordinary Meeting, on **Thursday**, March **7th**, 1907, the following papers will be communicated:

"The constitution of chaulmoogric and hydnocarpic acids." By M. Barrowcliff and F. B. Power.

"Volume changes which accompany transformations in the system $Na_2S_2O_3,5H_2O$." By H. M. Dawson and C. G. Jackson.

"Hydrolysis of amygdalin by acids." By R. J. Caldwell and S. L. Courtauld.

"Mandelonitrile-glucosides. The constitution of prulaurasin." By R. J. Caldwell and S. L. Courtauld.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 15/3/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 322.

Thursday, March 7th, 1907, at 8.30 p.m., Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. Frank Baker, F. S. Benton, L. H. Berry, F. J. Harris, A. T. King, B. D. Porritt, F. G. P. Remfry, A. H. Salway, and Frank Tutin were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

John Arthur Cunningham, B.A., Presidency College, Calcutta, India.

Samuel Duckworth, M.Sc., 78, Alexandra Road, Lowestoft, Suffolk.

Arthur George Harrington, Rochford, Westbury Road, Ealing, W.

Frederic William Rixon, M.Sc., Ph.D., Powderham Road, Newton Abbot, Devonshire.

William Griffiths Tonner, B.Sc., 26, Gordon Road, Kingston-on-Thames.

The CHAIRMAN read the names of the Fellows recommended by the Council for election as official and ordinary Members of Council, and announced that the name of Mr. F. H. Streatfeild had been proposed by another Fellow as an ordinary Member of Council.

Of the following papers, those marked * were read :

*50. "The constitution of chaulmoogric and hydnocarpic acids." By Marmaduke Barrowcliff and Frederick Belding Power.

In previous communications (Power and Gornall, *Trans.*, 1904, **85**, 838, 851) the isolation and properties of chaulmoogric acid, $C_{18}H_{32}O_2$ (m. p. 68°), were described. It is optically active, having $[\alpha]_D +56°$, and was shown to contain both a closed ring and an ethylenic linking.

When chaulmoogric acid is oxidised in alkaline solution with limited quantities of potassium permanganate it yields *a-dihydroxydihydrochaulmoogric acid*, $C_{18}N_{32}O_2(OH)_2$ (m. p. 105° ; $[\alpha]_D +11{\cdot}6°$), *β-dihydroxydihydrochaulmoogric acid*, $C_{18}H_{32}O_2(OH)_2$ (m. p. 93° ; $[\alpha]_D -14{\cdot}2°$), and *hydroxyketodihydrochaulmoogric acid*, $C_{18}H_{32}O_4$. Further oxidation gives, on the one hand, an optically inactive tricarboxylic acid, $C_{18}H_{32}O_6$ (m. p. 68°), which is n-*pentadecane-aa′γ-tricarboxylic acid*, $CO_2H{\cdot}[CH_2]_2{\cdot}CH(CO_2H){\cdot}[CH_2]_{12}{\cdot}CO_2H$, and, on the other hand, formic acid and a keto-acid, $C_{17}H_{30}O_5$, previously described (*loc. cit.*), which is now shown to possess the formula

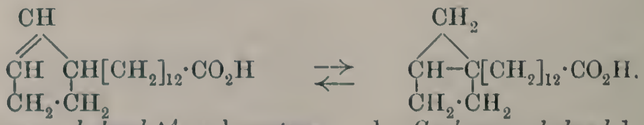
$$CO_2H{\cdot}[CH_2]_2{\cdot}CO{\cdot}[CH_2]_{12}{\cdot}CO_2H.$$

The latter compound, on oxidation, yields *n*-dodecanedicarboxylic acid, $[CH_2]_{12}(CO_2H)_2$, and *n*-undecanedicarboxylic acid,

$$[CH_2]_{11}(CO_2H)_2.$$

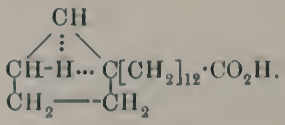
By the addition of hydrogen bromide to chaulmoogric acid, and its subsequent elimination, an optically active mixture of acids is obtained, which, when oxidised, furnishes a keto-acid, $C_{18}H_{32}O_5$ (m. p. 126°), to which the formula, $CO_2H{\cdot}CH_2{\cdot}CHMe{\cdot}CO{\cdot}[CH_2]_{12}{\cdot}CO_2H$, is ascribed.

The results obtained can be explained by assigning to chaulmoogric acid both the following formulæ, and considering it to exist in a state of tautomerism between the two structures.

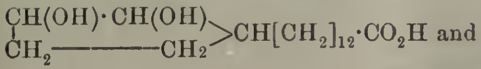


1-*a*-*Carboxy*-n-*dodecyl*-Δ^4-cyclo*pentene*. 1-*a*-*Carboxy*-n-*dodecyl*-1 : 4-bicyclo*pentane*.

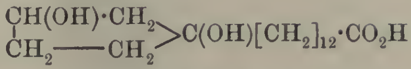
Its constitution may therefore be represented by the following formula :



To the dihydroxydihydrochaulmoogric acids the formulæ :



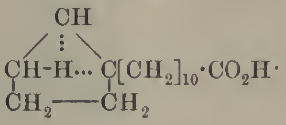
$$\begin{array}{l}CH(OH)\cdot CH(OH)\\ CH_2\text{———————}CH_2\end{array}\!\!>CH[CH_2]_{12}\cdot CO_2H$$ and



$$\begin{array}{l}CH(OH)\cdot CH_2\\ CH_2\text{——}CH_2\end{array}\!\!>C(OH)[CH_2]_{12}\cdot CO_2H$$

are ascribed, whilst dihydrochaulmoogric acid, $C_{18}H_{34}O_2$, is considered to be a mixture of *a-carboxy-*n*-dodecyl*cyclo*pentane* and i-*a-carboxy-*n*-dodecyl-2-methyl*cyclo*butane.*

Hydnocarpic acid, $C_{16}H_{28}O_2$ (m. p. 60° ; $[\alpha]_D$ +68°), a homologue of chaulmoogric acid (*Trans.*, 1905, **87**, 884), yielded on oxidation an acid, $C_{16}H_{28}O_6$ (m. p. 60°), which is n-*tridecane-aa′γ-tricarboxylic acid*, $CO_2H\cdot[CH_2]_2\cdot CH(CO_2H)\cdot[CH_2]_{10}\cdot CO_2H$, together with *n*-decanedicarboxylic acid, $[CH_2]_{10}(CO_2H)_2$. Its constitution may accordingly be represented by the following formula :



*51. "Hydrolysis of amygdalin by acids." By Robert John Caldwell and Stephen Lewis Courtauld.

With the object of obtaining further evidence as to the constitution of amygdalin, the authors have systematically studied the action of acids in comparison with that of enzymes on this "bioside."

The results show that, although amygdalin is ultimately resolved by acids into hydrogen cyanide, benzaldehyde, and two molecular proportions of glucose, the separation of the glucose is effected in two stages. The hydrolysis of the biose section of the molecule proceeds only at about one-sixth of the rate at which maltose is hydrolysed under like conditions. By carefully hydrolysing amygdalin by means of a normal solution of hydrogen chloride at 60°, the authors have prepared the mandelonitrile glucoside which E. Fischer obtained by subjecting the bioside to the action of an extract of yeast ; this method of obtaining the glucoside appears to be in some respects advantageous, the product being more easily purified.

*52. "Mandelonitrile glucosides. Prulaurasin." By Robert John Caldwell and Stephen Lewis Courtauld.

In order to ascertain whether the glucoside prepared by hydrolysing amygdalin is a direct product or one which has undergone isomeric change, the authors have subjected it to the action of alkalis; they find that it is converted into a substance identical with the isomeric substance prulaurasin, isolated by Hérissey from laurel leaves. Fischer's glucoside therefore bears the same relation to prulaurasin as amygdalin bears to the *iso*amygdalin described by Dakin, which is to be regarded as the derivative of inactive mandelonitrile, amygdalin and Fischer's glucoside being derived from *l*-mandelonitrile. As the rotatory power of prulaurasin is intermediate between that of Fischer's glucoside and that of sambunigrin, the second isomeride of Fischer's glucoside recently described by Bourquelot and Danjou, the latter must be regarded as the β-glucoside of *d*-mandelonitrile.

Characteristic acetyl derivatives have been prepared from amygdalin, *iso*amygdalin, Fischer's glucoside, and prulaurasin.

*53. "The hydrolysis of amygdalin by emulsin."

By Samuel James Manson Auld.

Although amygdalin is generally described as the maltoside of benzaldehydecyanohydrin since on hydrolysis it produces two molecules of dextrose, it is probable that the biose residue is an unknown $\alpha\beta$-disaccharide capable of hydrolysis both by emulsin and maltase.

The hydrolysis of amygdalin by emulsin may proceed in three ways, depending on the mode of attachment of the emulsin. Either mandelonitrile glucoside and dextrose are first produced with subsequent hydrolysis of the former, or benzaldehydecyanohydrin and the $\alpha\beta$-disaccharide are formed, and the latter then resolves into two molecules of dextrose, or, lastly, the amygdalin may undergo fission into the three components by direct abstraction of the dextrose residue attached to the benzaldehydecyanohydrin molecule. The experiments so far carried out indicate that the second process of cleavage is the true one.

DISCUSSION (on the three foregoing papers).

Dr. McKENZIE asked whether two mandelonitrile glucosides had been obtained, where the relationship is similar to that which exists between amygdalin and *iso*amygdalin, and, further, if the mandelonitrile glucoside described was racemic as regards the mandelic complex, had the fractional hydrolysis of this compound been studied?

Dr. HENRY stated that the report on "Cyanogenesis in Plants," prepared by Professor Dunstan and himself for the York Meeting of the British Association, was mainly a compilation of the published information then available on the subject, and consequently the reference there to amygdalin as a derivative of maltose did not commit the authors of the Report to that view of the constitution of the biose residue of the glucoside, and, in fact, the nature of the sugar residue of amygdalin was then under investigation by Dr. Auld, who had been associated recently with the authors in their work on cyanogenetic glucosides.

The interest shown of late in this subject had been created by the work done at the Imperial Institute since 1900, and it had been the intention of Professor Dunstan and himself to investigate fully the relationship of Fischer's mandelonitrile glucoside to prulaurasin and sambunigrin. In view of the fact that Professor Dunstan and he were well known to be at work in this field, it was unfortunate that Messrs. Caldwell and Courtauld had, without consultation, commenced work on these three isomerides.

Dr. AULD regretted that he was not aware that this investigation had been undertaken, as he had been at work on the problem of the constitution of the biose residue of amygdalin for some time. It was an entirely erroneous assumption that the maltose structure of this residue had been taken for granted. Dr. Henry's article in *Science Progress* (July, 1906) clearly showed that the exact nature of the sugar residue in these glucosides had not been settled. The results of Messrs. Caldwell and Courtauld's communication did not throw much new light on the actual configuration of the biose residue.

*54. "Electrolytic reduction. Part III." By Herbert Drake Law.

The products of electrolytic reduction of the aromatic aldehydes in alkaline solution are compounds of the hydrobenzoin type, but this reaction is completely altered when a methyl group is substituted in the ortho- or meta-position of the benzene nucleus. In the latter case, compounds of a resinous nature are obtained. Thus *p*-tolualdehyde gives a well-defined crystalline substance, whilst *m*- and *o*-tolualdehydes yield nothing but resins. The resinifying effect of a single substitution may, however, be neutralised by the introduction of a second group in a similar position on the opposite side of the nucleus. Thus with 3 : 5-dimethylbenzaldehyde a crystalline product is obtained, whilst 2 : 4-dimethylbenzaldehyde yields 40 per cent. of resin. Similar results were given by other aldehydes.

In acid solution, the products differed greatly at different temperatures. Thus in cold solutions primary alcohols were obtained to a large extent, but at 40° the product was of the hydrobenzoin type. Stilbenes and saturated hydrocarbons were also obtained.

DISCUSSION.

The PRESIDENT asked whether, in writing the formulæ of the aromatic aldehydes sometimes with the Kekulé benzene ring and at others with the "centric" arrangement of bonds, the author intended to convey the idea that the Kekulé formula represented the benzene molecule as unsaturated, and the "centric" formula as saturated.

Mr. LAW, in reply, said that the concentric formula best represents the constitution of the benzene nucleus. The introduction of a strain across the molecule distorts this configuration, the greatest mechanical effect being produced for a substitution in the ortho-position. In the latter case, Kekulé's formula probably nearly represents the state of the molecule. Between these two extremes it is possible that many other forms may exist.

*55. "New cerium salts."

By Gilbert Thomas Morgan and Edward Cohen.

Although in many cases the cerous salts of carboxylic acids, such as the cinnamate, are insoluble, uncrystallisable substances, it has now been shown that the aromatic sulphonates of this element are usually soluble, crystalline compounds resembling the thorium sulphonates previously described by one of the authors (*Abstr.*, 1904, i, 892). A representative series of these cerous sulphonates has been prepared together with several other salts of inorganic and organic acids.

DISCUSSION.

Dr. POWER called attention to the formula of cerium oxalate, which Dr. Morgan had referred to as being $Ce_2(C_2O_4)_3,9H_2O$, and stated that an investigation of this salt, conducted some years ago by Mr. Frank Shedden and himself (*J. Soc. Chem. Ind.*, 1900, **19**, 636), had conclusively shown that it contains 10 molecules of water. It was thus perfectly analogous in composition to the oxalates of lanthanum and didymium, which may be represented by the general formula

$$R'''_2(C_2O_4)_3,10H_2O.$$

Dr. MORGAN stated that he had, quite incidentally, represented cerous oxalate as $Ce_2(C_2O_4)_3,9H_2O$, as this appeared to be the accepted formula for this well-known salt, and was thus given in current works on pharmacy. He had not noticed Dr. Power's correction which showed that the oxalate was in reality a decahydrate, $Ce_2(C_2O_4)_3,10H_2O$.

56. "Volume changes which accompany transformations in the system $Na_2S_2O_3 : 5H_2O$." By Harry Medforth Dawson and Colin Gyrth Jackson.

The changes which take place in the system $Na_2S_2O_3 : 5H_2O$ when subjected to certain temperature variations have been investigated by the dilatometric method. Volume temperature curves which indicate the relationship of the various forms of the system were described. At a temperature of 25° the system has been obtained in the following six forms, each characterised by a definite volume: (1) primary pentahydrate, (2) secondary pentahydrate, (3) secondary tetrahydrate and saturated solution, (4) primary pentahydrate and saturated solution, (5) secondary monohydrate and saturated solution, (6) liquid.

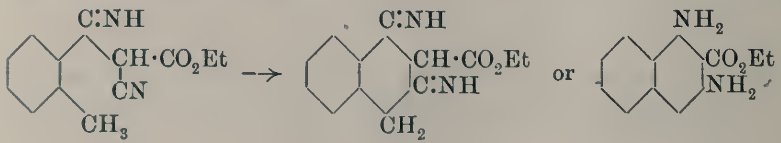
With an accurately calibrated dilatometer the volume occupied by the supercooled liquid of the composition $Na_2S_2O_3 : 5H_2O$ can be directly compared with the volumes of the primary and secondary pentahydrates and the specific gravities of these obtained with considerable accuracy. The transformation of the metastable secondary pentahydrate into the stable primary form affords an interesting lecture experiment.

57. "Depression of the freezing point of aqueous solutions of hydrogen peroxide by potassium persulphate and other compounds." By Thomas Slater Price.

Potassium persulphate causes a less molecular depression of the freezing point of aqueous solutions of hydrogen peroxide than it does of water, and the conclusion is drawn that an unstable compound is formed in solution (compare Friend, *Trans.*, 1906, **89**, 1092); similar results hold for potassium sulphate and hydrogen peroxide. In the case of sulphuric acid the molecular depression of hydrogen peroxide solutions is greater than that of water; this confirms the results of Jones and Murray (*Amer. Chem. J.*, 1903, **30**, 205), that sulphuric acid is dissociated to a greater extent in aqueous hydrogen peroxide than in water. Potassium hydrogen sulphate and hydrogen peroxide interact in concentrated solution with the production of potassium permonosulphate—no potassium persulphate ($K_2S_2O_8$) is formed—but it was not possible to obtain the pure salt. It was pointed out that a solution of potassium permonosulphate, in the presence of free acid, is much more stable than has been hitherto supposed.

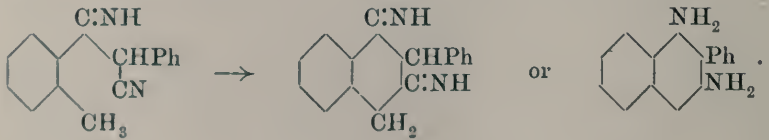
58. "The formation and reactions of imino-compounds. Part III. The formation of 1:3-naphthylenediamine and its derivatives from *o*-toluonitrile." By Ernest Francis Joseph Atkinson, Harry Ingham, and Jocelyn Field Thorpe.

In Part II of this series it was shown that derivatives of benzene containing a saturated side chain of three carbon atoms substituted in the α-position by the nitrile group and in the β-position by the imino-group pass on treatment with cold concentrated sulphuric acid into derivatives of 1:3-naphthylenediamine. The authors have now applied this reaction to those derivatives of benzene which possess a saturated side chain of two carbon atoms substituted in the α-position by a nitrile group and in the β-position by an imino-group, and which contain a methyl group in the benzene ring in the ortho-position in respect to the side chain. The two compounds chosen to illustrate this generalisation were ethyl β-imino-α-cyano-β-*o*-tolylpropionate (I), which was found to be quantitatively converted into ethyl 1 : 3-naphthylenediamine-2-carboxylate (II) on being dissolved in cold concentrated sulphuric acid :



(I) (II)

and β-imino-α-cyano-α-phenyl-β-*o*-tolylethane (III), which under the same conditions passed into 1 : 3-diamino-2-phenylnaphthalene (IV) :

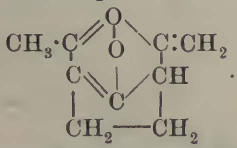


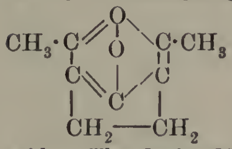
(III) (IV)

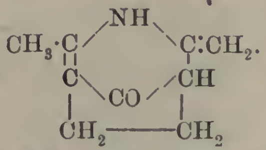
Evidence was also brought forward indicating that the closing of the ring both in the present instances and also in those dealt with in Part II is due to the formation of a definite addition product formed by the action of concentrated sulphuric acid on the nitrile group.

59. "The action of ethylene dibromide and of propylene dibromide on the disodium derivative of diacetylacetone."

By Alexander William Bain.

By the action of ethylene dibromide on anhydrous disodium diacetylacetone, the author has isolated a *compound* having the formula $C_9H_{10}O_2$, to which he ascribes the constitution .

This substance melts at 62—63°, and possesses the remarkable faculty of undergoing isomeric change to a pyrone derivative, namely, , when heated with concentrated hydrochloric acid. The *hydrochloride* and *platinichloride* of this derivative have been prepared and analysed.

Ammonia reacts with the compound to give 

Similar derivatives have been prepared by the action of propylene dibromide, but both alkyl and alkylene halides of higher molecular weight react with great difficulty and then only to give very unstable compounds.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Archbutt, *Leonard,* and **Deeley,** *R. Mountford.* Lubrication and lubricants. A treatise on the theory and practice of lubrication, and on the nature, properties, and testing of lubricants. 2nd edition. pp. xxxi + 528. ill. London 1907. (*Recd.* 6/3/07.)

From L. Archbutt, Esq.

Bernthsen, *A.* A text-book of organic chemistry. The English translation from the German, edited and revised to date by *J. J.* **Sudborough.** pp. xvi + 658. London 1906. (*Recd.* 6/3/07.)

From Professor J. J. Sudborough.

Freeman, *John R.* On the safeguarding of life in theatres. An Address made at the opening of the Annual Meeting of the American Society of Mechanical Engineers in New York City, December 4, 1905. Reprinted from the Transactions of the Society. pp. 106. ill. [New York] 1906. (*Recd.* 1/3/07.) From the Author.

Pauli, *Wolfgang.* Physical chemistry in the service of medicine. Authorised translation by *Martin H.* **Fischer.** pp. ix + 156. New York 1907. (*Recd.* 27/2/07.)
From the Publishers: Messrs. John Wiley and Sons.

Plimmer, *R. H. Aders.* Practical physiological chemistry. 2 vols. pp. 55, 83. London [1907]. (*Recd.* 5/3/07.) From the Author.

Pozzi-Escot, *Em.* The toxins and venoms, and their antibodies. Authorised translation by *Alfred I.* **Cohn.** pp. vii + 101. New York 1906. (*Recd.* 27/2/07.)
From the Publishers: Messrs. John Wiley and Sons.

Shepperson, *William.* Field to dairy. 2nd edition. pp. 65. London 1907. (*Recd.* 28/2/07.) From the Author.

West Indies, *Imperial Department of Agriculture.* Lectures to sugar planters. pp. viii + 176. [Barbados] 1906. (*Recd.* 23/2/07.)
From the Department.

II. *By Purchase.*

Hammarsten, *Olof.* Festschrift Olof Hammersten zu seinem fünfundsechzigsten Geburtstage den 21 sten August 1906, gewidmet. pp. xxxi + [635]. Upsala 1906. (*Recd.* 23/2/07.)

Ries, *Heinrich.* Clays: their occurrence, properties, and uses. With especial reference to those of the United States. pp. xvi + 490. ill. New York 1906. (*Recd.* 23/2/07.)

Thomson, *J. J.* Conduction of electricity through gases. 2nd edition. pp. viii + 678. ill. Cambridge 1906. (*Recd.* 23/2/07.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Friday, March 22nd, 1907** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets must be received not later than Friday, March 15th next.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, made payable to "Mr. S. E. Carr" and addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

At the Annual General Meeting on Friday, March 22nd, the President will deliver an address entitled "The Position and Prospects of Chemical Research in Great Britain."

At the next Ordinary Meeting on **Thursday, March 21, 1907**, the following papers will be communicated:

"The synthesis of polypeptides." By Emil Fischer.

"Organic derivatives of silicon. Part III. *dl*-Benzylmethylethylpropylsilicane and experiments on the resolution of its sulphonic derivative." By F. S. Kipping.

"The reduction of carbon dioxide to formaldehyde in aqueous solutions." By H. J. H. Fenton.

"The mechanism of the rusting of iron." By G. T. Moody.

"Some compounds of guanidine with sugars. Part I." By R. S. Morrell and A. E. Bellars.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 28/3/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 323.

Thursday, March 21st, 1907, at 8.30 p.m., Sir HENRY E. ROSCOE, F.R.S., Past President, in the Chair.

Messrs. W. J. Bowis, L. M. Deane, E. W. L. Foxall, W. Godden, C. M. W. Grieb, and J. L. Simonsen were formally admitted Fellows of the Society.

Before commencing the business of the Society, Sir HENRY ROSCOE said that the Fellows would have learnt with great regret of the loss which their science, and especially French chemistry, had to deplore in the sudden and pathetic death of Marcellin Berthelot. This was not the occasion to dwell upon the important work which he had accomplished or on his noble character. These considerations would doubtless be fully dealt with hereafter. All that the Fellows of the Society now could do was to express their grief at his death and their sympathy with his family.

The CHAIRMAN also alluded with feeling to the death of their old Fellow, Prof. Warington.

Certificates were read for the first time in favour of Messrs.:

Kenneth Somerville Caldwell, B.Sc., Ph.D., St. Bartholomew's Hospital, E.C.

John Jacob Fox, 6, Alkham Road, Stamford Hill, N.

Joseph Henry Hall, B.Sc., 84, The Grove, Wandsworth, S.W.
Thomas Featherstone Harvey, 84, Henry Road, West Bridgford, Nottingham.
Edward Houghton, Glenhyrst, 106, Saltergate, Chesterfield.
Carl Lewis, P.O. Box 36, Johannesburg, S. Africa.
Herbert Victor Mitchell, 26, Brookfield Avenue, Walthamstow.
George Colleymore Sturrock, Capt., R.A., Arubankad, Nilgiris, India.
Sam Mortimer Sutcliffe, 4, Clive Place, Bradford.

Of the following papers, those marked * were read:

*60. "Synthesis of polypeptides." By Emil Fischer.

Continuing his work on the synthesis of polypeptides the author has prepared an octadecapeptide containing fifteen glycocoll and three *l*-leucine residues.

Pentaglycylglycine was allowed to react with *d*-bromo*iso*capronyldiglycylglycyl chloride, and the product so obtained was treated with ammonia with formation of *l*-leucyloctaglycylglycine. By a repetition of this series of reactions the octadecapeptide, *l*-leucyltriglycyl-*l*-leucyltriglycyl-*l*-leucyloctaglycylglycine,

$$NH_2\cdot CH(C_4H_9)\cdot CO[NH\cdot CH_2\cdot CO]_3\cdot NH\cdot CH(C_4H_9)\cdot CO[NH\cdot CH_2\cdot CO]_3-$$
$$-NH\cdot CH(C_4H_9)\cdot CO[NH\cdot CH_2\cdot CO]_8\cdot NH\cdot CH_2\cdot CO_2H,$$

has been synthesised.

Discussion.

The Chairman said that he only voiced the feeling of the Society when he expressed his admiration for the interesting and remarkable lecture to which they had all listened with pleasure. In reciprocating to the full the words which had fallen from Professor Armstrong's lips as to the wonderful character of the researches which Professor Fischer had described, he remarked that whilst they looked upon these researches as typical of the great strides made in German chemical science, he ventured to think that Professor Fischer would agree with him when he said that he believed that the work done by the Fellows of our Chemical Society at the present time would bear not unfavourable comparison, both as to quality and quantity, with that which is now being carried out in Germany. Indeed, when he looked back to the early years of the Society, as his friend Sir William Perkin and he could do, and remembered the progress which it had made, the activity which the Fellows of the Society had shown in recent years in advancing the progress of their science struck him as most remarkable, and this in spite of the many drawbacks which have often been said to discourage original research in England. We could not indeed vie with Germany in the special department of research which had just been laid before the Society, and this for a very simple reason, that there was only one Emil Fischer.

*61. "Organic derivatives of silicon. Part III. *dl*-Benzylmethylethylpropylsilicane and experiments on the resolution of its sulphonic derivative." By Frederic Stanley Kipping.

dl-Benzylmethylethylpropylsilicane, SiMeEtPrBz (*Proc.*, 1905, 21, 65), is sulphonated by sulphuric acid at about 130°, yielding a mixture of acids of which two were isolated in the form of their *l*-menthylamine salts.

Analyses of one of these salts seem to show that it is derived from *benzylethylpropylsilicolsulphonic acid* and has the formula

$$EtPrSi(OH)\cdot CH_2\cdot C_6H_4\cdot SO_3H,C_{10}H_{21}N,$$

but as it is formed in small amount only it has not been very thoroughly investigated; the formation of such an acid from the silicohydrocarbon would necessitate the hydrolytic separation of the methyl group in a manner similar to that in which the phenyl group is displaced on sulphonating phenylbenzylethylpropylsilicane (*Trans.*, 1907, 91, 224). The salt crystallises in prisms and melts at 210—212°.

The second *l*-menthylamine salt isolated from the mixture is derived from dl-*benzylmethylethylpropylsilicanesulphonic acid* and has the formula $SiMeEtPr\cdot CH_2\cdot C_6H_4\cdot SO_3H,C_{10}H_{21}N$. This compound is much more easily obtained from the product of the sulphonation of benzylmethylethylpropylsilicane with chlorosulphonic acid. It crystallises best ($+2H_2O$) from wet, light petroleum and when dehydrated melts at 122—123°.

The l-*menthylamine, quinine, cinchonidine, cinchonine, narcotine* and several other salts of this *dl*-silicanesulphonic acid have been crystallised fractionally under various conditions, but without the faintest indication of a resolution of the acid having been observed.

*62. "The reduction of carbon dioxide to formaldehyde in aqueous solution." Henry John Horstman Fenton.

The author finds that by the action of metallic magnesium, under appropriate conditions, on an aqueous solution of carbon dioxide, recognisable quantities of formaldehyde can be obtained and that the amounts are considerably increased if weak bases, such as ammonia, aniline, phenylhydrazine or aluminium hydroxide, are also present.

Further, it is found that formic acid may readily be reduced, in part at any rate, to formaldehyde by the action of magnesium so that the desired reduction of carbon dioxide may be effected also in two stages, with formic acid as the intermediate product.

*63. "The mechanism of the rusting of iron."

By Gerald Tattersall Moody.

The author has previously shown that the presence of acid is essential for rusting to occur. The following experiment enables the exact mechanism of the production of rust to be visualised :—In the bottom of a glass cylinder are placed some rods of bright iron such as French nails. These are only loosely packed, for the most part heads upward, and are so arranged that some of them remain vertical whilst others occupy inclined positions. Recently boiled distilled water is then poured into the cylinder until it stands about one and a half inches above the heads of the nails. The mouth of the cylinder is loosely closed with a sheet of paper so as to exclude dust and at the same time to allow free access of air to the water, whereby carbonic acid and oxygen are absorbed. In the course of twenty-four hours the water shows signs of becoming turbid and shortly afterwards a copious separation of brown particles from the solution is distinctly observed. These brown particles are continuously formed and gradually settle on the heads of the nails and on the upper parts only of those nails which are inclined. The under parts of the inclined nails and the vertical nails remain bright, no general corrosion of the surfaces being observable. At the end of seven days a thick layer of hydrated ferric oxide has collected on the upper surfaces of the nails and also on the bottom of the cylinder. If a sheet of hardened filter paper or some other material, which allows of diffusion, be placed in a horizontal position immediately over the nails at the beginning of the experiment, the rust which separates from the solution above it gradually collects on its upper surface and eventually forms a thick layer.

The separation of the rust from the water and its non-formation on the surface of the iron can be explained only as an oxidation of ferrous iron actually in solution. This is in strict accordance with the experimental evidence already advanced and shows that, in rusting, iron is first dissolved with formation of ferrous salt which subsequently oxidises to rust.

Discussion.

The Chairman remarked that all those present must be much struck by the extremely simple and convincing experiments which the author had described, showing that the first step towards the rusting of iron was that the metal entered into solution in the liquid. He ventured to doubt, however, whether the author had even now got to the bottom of the subject, simple though it apparently was, because he had not explained how the solution of the metal was effected, whether this solution occurred in presence of carbonic acid only or whether in its absence.

Dr. MOODY said that he had already described experiments which showed conclusively that the presence of acid is essential for rusting to occur (*Trans.*, 1906, **89**, 720). In absence of acid, pure iron was allowed to remain in contact with water and oxygen for several weeks without even one speck of rust being formed, and without the iron undergoing any change either in appearance or in weight. It was specially noteworthy that when pure iron was placed in a dilute solution of hydrogen peroxide free from acid, no oxidation or other change in the iron occurred, although oxygen was freely evolved from every part of the immersed metal. In this way the indifference of iron towards oxygen in presence of water could be easily and conclusively demonstrated. In the experiment he had shown the Society that evening, the iron was undoubtedly dissolved by carbonic acid, and the ferrous bicarbonate thus formed was converted into rust by oxygen, which, simultaneously with the carbonic acid, diffused into the solution from the atmosphere.

*64. "Influence of non-electrolytes and electrolytes on the solubility of sparingly soluble gases in water. The question of hydrates in solution." By James Charles Philip.

It is suggested that the influence of non-electrolytes and electrolytes on the solubility of gases may be adequately interpreted by reference to two factors. Firstly, it may be supposed that the non-electrolyte or electrolyte takes no part in the absorption, and accordingly the standard absorbing volume should be not 1 c.c. or 1 litre of the solution, but that volume of the solution which contains 1 gram or 1000 grams of the pure solvent. Secondly, hydration of the non-electrolyte or electrolyte may occur, and it may be supposed that the solvent which is thus attached is no longer free to absorb the gas. These suggestions have been tested with satisfactory results by reference to available experimental data, and the values found for the average molecular hydration of dissolved salts are in fair agreement with the values reached by other and widely different methods.

Discussion.

Sir **William Ramsay** asked whether it must not be held that both the solvent and the solute take part in dissolving a gas. For example, a solution of sugar in water is a mixture of liquid sugar and liquid water, and it might be supposed that hydrogen would dissolve in both water and in sugar according to its solubility in each, and to their relative amount.

Mr. R. J. **Caldwell** drew attention to the fact that Euler and others had recognised that the absorption coefficients of the permanent gases, as well as the solubility of ethyl acetate, are equally affected by the presence of dissolved solids. It had long been clear to him that this regularity could be accounted for by assuming that a diminution of the amount of free water was caused by the formation of hydrates of the dissolved substance; most of the material had been collected for a communication on the subject. From the very accurate values given by Winkler for the solubility of oxygen, making due allowance for the fact that Winkler used volume-normal solutions, he had calculated that the average degree of hydration of calcium chloride in a solution of gram-molecular strength (weight-normal) was in the ratio

$$CaCl_2 : 21H_2O.$$

This result is in accord with the value $CaCl_2 : 22H_2O$ he had obtained by the sugar inversion method; in the case of other salts, a like agreement had been found. It was difficult to see how such agreements could be reconciled with the ionic dissociation hypothesis.

Dr. **Philip** said that it was certainly possible that hydrogen was soluble to some extent in chloral hydrate and sucrose, but it appeared unlikely in view of the fact that the average molecular hydration calculated on the basis of the two factors suggested in the paper agreed with values obtained by methods into which the question of solubility of hydrogen in these substances could not possibly enter.

The view that hydrates exist in aqueous solutions of electrolytes was not inconsistent with a general adherence to the ionic theory.

*65. "A new class of organo-metallic compounds. Preliminary notice. Trimethylplatinimethyl hydroxide and its salts." By William Jackson Pope and Stanley John Peachy.

No alkyl compounds of metals belonging to group 8 of the periodic table have hitherto been described. The authors find that the chlorides, or in some cases the oxides, of iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, iridium, and platinum, belonging to group 8, and of gold, belonging to group 1, react vigorously with magnesium methyl iodide; they desire to reserve the study of the action of Grignard's reagent on compounds of the metals named.

Trimethylplatinimethyl iodide, $(CH_3)_3PtI$, is formed by the action of platinic chloride dissolved in ether on magnesium methyl iodide in ethereal benzene solution; after treating with water and extracting with benzene, the benzene solution yields the new compound on evaporation. It crystallises in straw-yellow plates, is not volatile, and decomposes on heating with slight explosion; it is very stable towards reagents, and is not attacked in the cold by strong caustic alkalis, alkali sulphides, or by nitric, hydrochloric, and sulphuric acids. It is not further acted on by magnesium methyl iodide. On boiling for several hours with silver hydroxide in a moist mixture of benzene and acetone, it is converted into *trimethylplatinimethyl hydroxide*, $(CH_3)_3Pt{\cdot}OH$; this substance is insoluble in water, gives no alkaline reaction with litmus, and crystallises in colourless rhombic dodecahedra belonging to the cubic system.

Trimethylplatinimethyl nitrate, $(CH_3)_3Pt{\cdot}NO_3$, obtained by dissolving the hydroxide in nitric acid, crystallises in colourless plates and is freely soluble in water. On adding an alkali chloride to its aqueous solution, *trimethylplatinimethyl chloride*, $(CH_3)_3PtCl$, is precipitated; this salt crystallises from chloroform in colourless, rhombic dodecahedra belonging to the cubic system. In a similar manner a number of other salts have been prepared, including the *bromide* and the *cyanide*; the latter is hydrolysed on heating with caustic potash with evolution of ammonia.

ISCUSSION.

The Chairman congratulated the authors on having opened out an entirely new branch of investigation which might indeed be said to be a wonderful "find."

66. "Some compounds of guanidine with sugars. Part I." By Robert Selby Morrell and Albert Ernest Bellars.

When an alcoholic solution of guanidine is added to dextrose, lævulose, mannose, arabinose, rhamnose, galactose, or maltose, dissolved in ethyl alcohol, white, microcrystalline precipitates are obtained. The general formula for dextrose-, lævulose-, and mannose-guanidine is $3C_6H_{12}O_6,2CN_3H_5$. In $N/2$ solutions, the compounds are dissociated into their components to the extent of 71 per cent. The depression of the freezing points of mixed dextrose and guanidine solutions was determined on the lines of H. Euler's researches (*Ber.*, 1905, **38**, 2551; 1906, **39**, 350), and the results confirm his view as to the acid character of carbohydrates in aqueous solution. The strength of guanidine as a base compared with caustic soda was determined by (*a*) the saponification of ethyl acetate, (*b*) the velocity of fall in rotation angle of a hyoscyamine solution in the presence of guanidine (Will and Bredig, *Ber.*, 1888, 21, 2777). The strengths of guanidine and caustic soda were found to be in the ratio of 0·8 : 1. Aqueous solutions of dextrose-, lævulose-, or mannose-guanidine show a gradual fall in optical rotation to a minimum value, which is the same for the three compounds. This behaviour is similar to that investigated by Lobry de Bruyn in the action of alkalis on sugars. The results obtained from the study of the mutarotation of solutions of dextrose-, lævulose-, or mannose-guanidine may be summarised as follows: (1) the fall in optical rotation to a constant minimum represents an apparent equilibrium in the case of dextrose- and lævulose-guanidine between two sugars through an intermediate substance X, the concentration of which is very small, $G \longleftrightarrow X \longleftrightarrow F$. (2) The velocity constants for the transformation of dextrose into lævulose, and *vice versâ*, were found to be 0·0015 and 0·0021 respectively; the velocity constants for the change of mannose into lævulose and dextrose are 0·0005 and 0·00036 respectively. The velocity of the reverse change of lævulose and dextrose into mannose is very small. (3) There is a slow disappearance of X, the intermediate substance, to form acids. When optical equilibrium has been reached, the ratio of lævulose to dextrose remains constant until the formation of acids ceases. The changes may be represented by the scheme

$$\begin{tikzcd}[row sep=small] & G \arrow[dr, leftrightarrow] & & \\ M \arrow[ur, dashed] \arrow[dr] & & X \arrow[r] & \text{acids.} \\ & F \arrow[ur, leftrightarrow] & & \end{tikzcd}$$

67. "The action of aluminium chloride on naphthalene. Formation of ββ-dinaphthyl, tetranaphthyl, and tetramethylerythrene." By Annie Homer.

The action of aluminium chloride on naphthalene has been studied in detail. ββ-Dinaphthyl, $C_{20}H_{14}$, was formed, as had been indicated by Friedel and Crafts. Besides this compound, three new hydrocarbons were isolated, namely: (1) an oil, $C_{14}H_{16}$, probably *tetramethylnaphthalene*; (2) a resinous hydrocarbon, $C_{26}H_{22}$, to which the name *tetramethylerythrene* has been given; and (3) a yellowish-red solid, *tetranaphthyl*, $C_{40}H_{26}$.

Tetramethylerythrene is deep red, and its solutions, besides being highly fluorescent, show two absorption bands in the blue and violet portions of the spectrum respectively.

ββ-Dinaphthyl and tetranaphthyl are produced by condensation of the naphthalene molecules. The mode of formation of tetramethylerythrene is open to question.

68. "Mercurous hyponitrite." By Prafulla Chandra Rây.

The author has succeeded in preparing this salt in a purer form than that described in a former paper (*Trans.*, 1897, 71, 348). A solution of mercurous hyponitrite in nitric acid, unlike the silver salt, undergoes slow dissociation into mercury and mercuric hyponitrite.

69. "The decomposition of mercurous and silver hyponitrites by heat." By Prafulla Chandra Rây and Atul Chandra Gañguli.

The gaseous products of decomposition of mercurous hyponitrites are nitrogen, nitrogen monoxide, and nitrogen dioxide, the proportion of the first being very small.

Silver hyponitrite also yields the same gases with a much larger proportion of nitrogen dioxide. The authors are of opinion that these salts have both an oxylic and imidic constitution.

70. "Studies in optical superposition. Part III."
By Thomas Stewart Patterson and John Kaye.

l-Menthyl diacetyl-*i*-tartrate has been prepared and its rotation has been determined both in the homogeneous state and in solution in ethyl alcohol, benzene, and nitrobenzene. The results, taken in conjunction with those previously published (*Trans.*, 1905, 87, 33; 1906 89, 1884), furnish for the first time thoroughly valid evidence as to the untenability of van't Hoff's assumption regarding optical superposition.

The following table exhibits this comparison at different temperatures for the homogeneous substances:

t°.	I. *l*-Menthyl diacetyl-*d*-tartrate.	II. *l*-Menthyl diacetyl-*l*-tartrate.	III. Mean of I and II.	IV. *l*-Menthyl diacetyl-*i*-tartrate.	Δ IV—III.
20°	−256°	−360°	−308°	−274°	34°
100	228	382	305	280	5
130	216	390	303	282	21

For solutions, the values found were as follows:

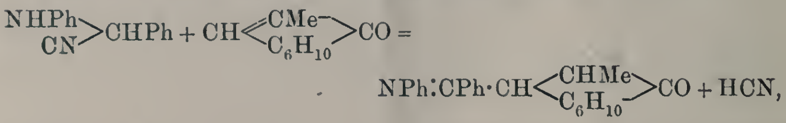
Solvent.	I. *l*-Menthyl diacetyl-*d*-tartrate.	II. *l*-Menthyl diacetyl-*l*-tartrate.	III. Mean of I and II.	IV. *l*-Menthyl diacetyl-*i*-tartrate.	Δ. IV—III.
Ethyl alcohol	−268° (p : 5)	−367° (p : 5)	−317·5°	−292° (p : 0·455)	25·5°
Benzene	285 ,,	313 ,,	299·0	248 (p : 5·2)	51·0
Nitrobenzene	238 ,,	355 ,,	296·5	244 (p : 4·38)	52·5

Both in the homogeneous condition and in solution therefore the rotation of the *i*-tartrate is markedly greater (that is, less negative) than the means of the values for the *d*- and *l*-tartrates, and this furnishes conclusive evidence that the rotation due to a given asymmetric atom in a compound of two or more asymmetric radicles is not independent of the configuration of the other group or groups with which it is combined.

71. "An extension of the benzoin synthesis."
By Reginald William Lane Clarke and Arthur Lapworth.

Although mandelonitrile or its benzoyl derivative is too unstable to condense with $\alpha\beta$-unsaturated ketones, yet its aniline derivative, benzylideneaniline hydrocyanide, can be made to do so.

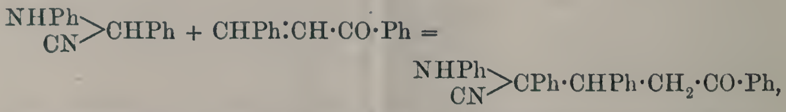
With carvone, *phenylimino-β-benzoyldihydrocarvone* is obtained :



$$\begin{matrix}\mathrm{NHPh}\\\mathrm{CN}\end{matrix}\!>\!\mathrm{CHPh}+\mathrm{CH}\!<\!\begin{matrix}\mathrm{CMe}-\\\mathrm{C_6H_{10}}\end{matrix}\!>\!\mathrm{CO}=\mathrm{NPh{:}CPh\cdot CH}\!<\!\begin{matrix}\mathrm{CHMe}\\\mathrm{C_6H_{10}}-\end{matrix}\!>\!\mathrm{CO}+\mathrm{HCN},$$

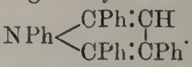
and this, on hydrolysis with acids, yields two stereoisomeric *β-benzoyldihydrocarvones.*

With benzylideneacetophenone, *γ-cyano-α-benzoyl-γ-anilino-βγ-diphenylpropane* is the product :



$$\begin{matrix}\mathrm{NHPh}\\\mathrm{CN}\end{matrix}\!>\!\mathrm{CHPh}+\mathrm{CHPh{:}CH\cdot CO\cdot Ph}=\begin{matrix}\mathrm{NHPh}\\\mathrm{CN}\end{matrix}\!>\!\mathrm{CPh\cdot CHPh\cdot CH_2\cdot CO\cdot Ph},$$

the constitution of which was shown by converting it by heat into water, hydrogen cyanide, and tetraphenylpyrrole, $\mathrm{NPh}\!<\!\begin{matrix}\mathrm{CPh{:}CH}\\\mathrm{CPh{:}CPh}\end{matrix}$.



In neither instance does benzylideneaniline alone afford any analogous products. These condensations were shown to be extensions of the well-known "benzoin synthesis" as interpreted by one of the authors (*Trans.*, 1903, 83, 1004).

72. "Interaction of starch and carbon disulphide. Xanthogenic esters of starch." By Charles Frederick Cross, Edward John Bevan, and John Frederick Briggs.

Alkali starch in its hydrated forms is a gelatinous impenetrable mass which is only superficially attacked by carbon disulphide.

Starch moistened with the disulphide and then treated with a sodium hydroxide solution (15 to 20 per cent.) is brought into the condition for quantitative reaction and conversion into the xanthogenic ester (sodium salt). The derivatives are analogous in all respects to those of cellulose (*Trans.*, 1893, 63, 837).

73. "The estimation of small quantities of nitrogen peroxide." By Robert Robertson and Sidney Scrivener Napper.

The method depends on the changes observed in the characteristic absorption spectrum of nitrogen peroxide as its concentration in dilute mixtures is increased. It was found that a few of the more prominent groups of lines were visible at a concentration of 0·05 per cent. nitrogen peroxide, and that as the proportion was raised the lines increased in intensity and number until the violet end of the spectrum was completely absorbed in mixtures approaching a concentration of 1·0 per cent. These differences are sufficiently well marked to enable a process to be worked out for the quantitative estimation of the concentration by comparison with standard mixtures. Photographic comparison was employed, and for this purpose a series of standard photographs covering a range of concentration from 0·05 to 1 per cent. was prepared.

The method when applied to the estimation of small quantities of nitrogen peroxide in air gives very satisfactory results, and the process which is applicable to any gaseous mixture has been used successfully for the investigation of the gases evolved during the slow decomposition of guncotton.

74. "The evolution of nitrogen peroxide in the decomposition of guncotton." By Robert Robertson and Sidney Scrivener Napper.

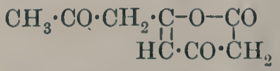
Previous investigators have given accounts of experiments in which guncotton was slowly decomposed at temperatures near 130° in a vacuum and in a current of carbon dioxide, and have stated that only a small quantity of nitrogen peroxide was evolved, or have made no reference to its presence. With the help of the method described by the authors (compare preceding paper) a careful study has been made of the gases given off by guncotton when heated under various conditions.

These include heating (1) in a vacuum; (2) in a stream of carbon dioxide; (3) in an unchanged atmosphere of carbon dioxide; (4) in nitrogen dioxide, and (5) in air. In all cases more than 10 per cent. of the total nitrogen evolved was in the form of nitrogen peroxide, and a study of the results shows that the proportion is largely dependent on the conditions of experiment; the deposition of water and prolonged contact with the heated guncotton tend to reduce it, and when these two conditions are not present the proportion rises to 40—50 per cent. This occurs when the guncotton is heated under the conditions of the Will test, and reduction of the rate of the current of carbon dioxide causes a reduction of the proportion of nitrogen peroxide evolved. This effect is apparently due to the action of the nitrogen peroxide on the guncotton, and is accompanied by a rise in the total amount of nitrogen evolved, indicating that oxides of nitrogen cause an increase in the rate of decomposition of guncotton.

75. “An isomeric change of dehydracetic acid.” By John Norman Collie and Thomas Percy Hilditch.

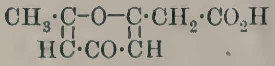
During the preparation of a large quantity of triacetic lactone, it has been noticed that if sulphuric acid of about 85 per cent. instead of about 90 per cent. is allowed to act on dehydracetic acid, the yield of triacetic lactone is much diminished. On pouring the product into water, an acid, $C_8H_8O_4$, isomeric with dehydracetic acid, has been separated. It has a molecular weight of 169, is a true acid, not a lactone, melts at 99°, and has an electrical conductivity $k = 0{\cdot}00152$. When heated to about 200° it is converted almost quantitatively into carbon dioxide and dimethylpyrone. On boiling with excess of strong solution of barium hydroxide it yields barium acetate, acetone, and barium malonate. A solution of the neutral sodium salt on boiling is converted into sodium dehydracetate, from which dehydracetic acid is precipitated by adding an acid.

The free acid, when heated with an excess of ammonia, gives the ammonium salt of a lutidonecarboxylic acid. This acid, $C_8H_8O_4$, seems to agree in all respects, except its electrical conductivity, with an acid obtained by Feist (*Annalen*, 1890, **257**, 253), and is a true pyronecarboxylic acid:



$$\begin{array}{l}CH_3\cdot CO\cdot CH_2\cdot C{-}O{-}CO \\ \qquad\qquad\quad\; HC\cdot CO\cdot CH_2\end{array}$$

Dehydracetic acid.



$$\begin{array}{l}CH_3\cdot C{-}O{-}C\cdot CH_2\cdot CO_2H \\ \quad HC\cdot CO\cdot CH\end{array}$$

Pyronecarboxylic acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Rey, *Jean.* Essais de Jean Rey. Édition nouvelle avec commentaire, publiée par *Maurice* **Petit.** pp. xxviii + 192. Paris 1907. (*Recd.* 13/3/07.) From the Publisher: A. Hermann.

Robertson, *Frederick D. S.* Practical agricultural chemistry. A manual of qualitative and quantitative analysis for agricultural students. pp. x + 210. ill. London 1907. (*Recd.* 13/3/07.) From the Publishers: Messrs. Baillière, Tindall, and Cox.

Sommerfeldt, *Ernst.* Physikalische Kristallographie vom Standpunkt der Strukturtheorie. pp. vii + 132. ill. Leipzig 1907. (*Recd.* 13/3/07.) From the Publisher: C. H. Tauchnitz.

Thoms, *H.* Ueber Mohnbau und Opiumgewinnung. pp. 60. ill. Berlin 1907. (*Recd.* 13/3/07.)

II. *By Purchase.*

Deutsches Bäderbuch, bearbeitet unter Mitwirkung des Kaiserlichen Gesundheitsamtes. pp. [viii] + civ + 535. Leipzig 1907. (*Recd.* 20/3/07.)

Tammann, *G.* Ueber die Beziehungen zwischen den inneren Kräften und Eigenschaften der Lösungen. Ein Beitrag zur Theorie homogener Systeme. pp. viii + 184. Hamburg 1907. (*Recd.* 20/3/07.)

Tappeiner, *H. v.*, und **Jodlbauer,** *A.* Die sensibilisierende Wirkung fluorescierender Substanzen. Gesammelte Untersuchungen über die photodynamische Erscheinung. pp. viii + 210. ill. Leipzig 1907. (*Recd.* 20/3/07.)

ERRATUM.

1907. P. 74, line 15 from top, *for* "**Cohen**" *read* '**Cahen.**"

At the next Ordinary Meeting on **Thursday, April 18th, 1907,** the following papers will be communicated :

"The magnetic rotation of hexatriene, $CH_2\colon CH\cdot CH\colon CH\cdot CH\colon CH_2$, and its relationship to benzene and other aromatic compounds, also its refractive power." By Sir W. H. Perkin.

"Aromatic azoimides. Part I. *p*-Hydroxyphenylazoimide." By M. O. Forster and H. E. Fierz.

"The action of hydrogen peroxide on potassium cyanide." By O. Masson.

"The action of ethyl oxalate on thioacetanilide and its homologues." By S. Ruhemann.

"Measurements of the velocities of saponification of the *l*-menthyl and *l*-bornyl esters of the stereoisomeric mandelic acids." By A. McKenzie and H. B. Thompson.

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Issued 29/4/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 324.

Friday, 22nd March, 1907. Annual General Meeting, Professor R. MELDOLA, F.R S , President, in the Chair.

Dr. G. D. Lander and Dr. J. F. Thorpe were appointed scrutators and the Ballot was opened for the election of Officers and Council for the ensuing year.

The PRESIDENT presented the Report of the Council on the progress of the Society during the past twelve months. The adoption of the Report of the Council was proposed by Prof. J. B. Harrison, seconded by Prof. W. Jackson Pope, and carried unanimously.

REPORT OF THE COUNCIL.

THE Council has the satisfaction of being able to report the continued prosperity of the Society and that, measured by the number of papers read and the number of Fellows on the list, there has been greater activity than in any previous year.

On the 31st December, 1905, the number of Fellows was 2,785. During 1906, 172 Fellows were elected and 2 reinstated, thus making a gross total of 2,959. The Society has lost 24 Fellows by death; 24 have resigned, the elections of 5 have become void ; 39 have been removed for non-payment of Annual Subscriptions, and 7 Life Compounders, whose addresses could not be found, have been removed

The total number of Fellows, therefore, on the 31st December, 1906, was 2,860, showing an increase of 75 over the number for the previous year.

The names of the deceased Fellows, with the dates of their election, are :

W. H. Chandler (1872).
F. J. Claudet (1852).
T. S. Davis (1876).
W. H. Edwards (1902).
M. H. Foye (1884).
C. H. B. Hambly (1859).
J. G. Hepburn (1853).
J. S. C. Heywood (1848).
G. H. Hurst (1885).
F. M. Lyte (1859).
C. W. Marsh (1881).
E. H. Miller (1897).
W. J. Orsman (1884).
B. Phillips (1889).
J. E. Pitman (1906).
T. Royle (1862).
F. Smith (1890).
T. D. Smith (1898).
H. J. P. Sprengel (1864).
W. S. Squire (1858).
J. A. Storey (1891).
C. Tookey (1855).
T. B. Tyson (1885).
A. Walker, Maj-Gen. (1868).

The following Fellows have resigned :

G. D. Atkinson.
J. Bateman.
W. C. T. Beasley.
Sir B. V. S. Brodie, Bt.
C. H. Burge.
J. M. Campbell.
H. E. Ellis.
J. C. Fell.
P. Haigh.
S. M. Haigh.
W. Harris.
E. Hughes.
R. B. Lee.
H. L. Leech.
H. P. Lewis.
W. C. Mackenzie.
A. S. Mayfield.
J. B. Moody.
J. W. Sandford.
G. T. S. Sichel.
W. H. Sodeau.
R. C. Styles.
G. E. Tomlins.
P. J. Vinter.

The names of the Life Compounders whose addresses cannot be found, and who have been removed therefore by the Council, are :

G. Crampton (1875).
J. Danson (1850).
A. A. Ferreira (1864).
A. W. Gillman (1865).
J. Hadkinson (1878).
F. E. Harman (1874).
James Millar (1848).

The number of the Fellows who were elected in the early part of the last century has been still further diminished by the death of Mr. F. J. Claudet, elected on 16th February, 1852; Mr. J. G. Hepburn, elected on 21st February, 1853; and of Mr. J. S. C. Heywood, who was elected on 3rd April, 1848.

The number of Honorary and Foreign Members at the close of 1905 was 34. No elections have been held during 1906, but the Society has to mourn the loss of Dr. Fedor Beilstein, who was elected

1st February, 1883, and who died on 19th October, 1906. The number of Honorary and Foreign Members at 31st December, 1906, was therefore 33.

Since the close of 1906, the Society has lost by death three more of its Honorary and Foreign Members, namely, Prof. Dr. D. I. Mendeléeff, (on 2nd February), Prof. Dr. Nicolai Menschutkin (on 4th February), and Prof. Henri Moissan (on 20th February).

During the year 1906, 236 scientific communications have been made to the Society, 176 of which have been published already in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of Transactions for 1906 contains 1,943 pages, of which 1,890 are occupied by 186 memoirs, the remaining 53 pages being devoted to the Cleve Memorial Lecture, the Report of the Annual General Meeting, and the Presidential Address; the volume for the preceding year contains 184 memoirs, which occupy 1,818 pages.

The Journal for 1906 contains also 4,541 abstracts of papers published mainly in foreign journals, which extend to 1,912 pages, whilst the abstracts for 1905 numbered 4,356, and occupied 1,828 pages.

The abstracts for 1906 may be classified as follows:

	Pages.	No. of Abstracts.
Part I.		
Organic Chemistry	1,000	1,745
Part II.		
General and Physical Chemistry		651
Inorganic Chemistry		559
Mineralogical Chemistry		128
Physiological Chemistry		486
Chemistry of Vegetable Physiology and Agriculture		343
Analytical Chemistry		629
	912	2,796
Total in Parts I. and II.	1,912	4,541

Among the first acts of the Council elected in March, 1906, was the appointment of a Finance Committee, and it was decided also that the names of the Members, together with those of the House, Library, Publication, and Research Fund Committees, should be read from the Chair at the Ordinary Meeting next after the Meeting of Council at which the Committees are formed.

In the previous session, and on a second occasion during the present one, the desirability of reading the minutes at an Ordinary Meeting has been called in question; for the guidance of Chairmen on this point it has been resolved that henceforth the minutes must be read as long as the present Bye-Laws remain in force.

The practice of holding the Ordinary Meetings of the Society on the first and third Thursdays of the month, reversion to which was announced in the last Annual Report, appears justified by the average attendance of Fellows, which has been well maintained. In order to relieve the pressure of business which has been usual at the first and last Meetings of the Session, it was decided to hold two extra Meetings, in October and July respectively.

The triennial award of the Longstaff Medal to the Fellow of the Society who, in the opinion of the Council, has done the most to promote Chemical Science by Research, was made, on the recommendation of the Research Fund Committee, to Prof. Walter Noel Hartley, F.R.S., in recognition of his spectrochemical investigations. The medal was presented on October 18th, 1906.

On the occasion of the International Celebration marking the Fiftieth Anniversary of the Foundation of the Coal Tar Colour Industry, an address of congratulation to Sir William Henry Perkin, F.R.S., was presented on behalf of the Society by the President. In accordance with the resolution of the public meeting at which the commemoration was inaugurated, a marble bust of Sir William Perkin, executed by Mr. F. W. Pomeroy, A.R.A., has been presented to the Society by the Committee administering the Fund subscribed in support of the celebration.

The Society has also received a Berzelius medal cast in selenium, presented by Mr. John Spiller, and Prof. J. M. Thomson, F.R.S., has presented an aqua-tint engraving of Dr. Thomas Thomson, F.R.S., Regius Professor of Chemistry in the University of Glasgow from 1818 to 1852.

During the vacation of 1906 an address was presented to the University of Aberdeen at the celebration of its fourth centenary, which took place in September. The congratulations of the Society were offered also to the distinguished Honorary and Foreign member, Professor Adolph Lieben, on the occasion of his seventieth birthday and fiftieth anniversary of his doctorate.

The desirability of applying for a supplemental Charter with a view to removing existing restrictions in regard to nationality and sex as affecting election to the Fellowship of the Society has been carefully considered by the Council. After receiving the report of a Special Committee consisting of Mr. Phipson Beale, Mr. Bousfield, Dr. Horace Brown, Dr. Moody, Professor Emerson Reynolds, Dr. T. E. Thorpe, Professor W A. Tilden, and the Officers, the Council resolved that for the guidance of Chairmen, only those Fellows who are British subjects can vote at meetings or be eligible for offices, and that the matter be made clear by adding to the gloss on the Charter, after the first paragraph, the words "but British subjects who are Fellows can alone exercise corporate rights, or be eligible for office."

The Council has resolved that, following the ordinary index of the Transactions, there shall appear a list of new compounds described in the original communications, tabulated according to the Richter system.

The alchemical and early chemical works presented to the Library by Sir Henry E. Roscoe have been catalogued (Proc., 1906, **22**, 209—233) and the volumes placed in a special book-case.

The number of books borrowed from the Library during 1906 was 1,126, as against 1,108 in the previous year. The additions to the Library comprise: (*a*) a collection of 136 alchemical and other books presented by Sir Henry E. Roscoe; (*b*) 121 books, of which 64 were presented, 385 volumes of periodicals, and 32 pamphlets, as against 165 books, 324 volumes of periodicals, and 48 pamphlets last year.

In January last the Council decided that during the remainder of the present Session the Library shall be kept open for the use of Fellows every Thursday from 10 a.m. until 9 p.m., except on those evenings on which the Society meets, when it will remain open until 10.30 p.m.

The annual income of the Research Fund from its investments is £219 17*s*. 0*d*., and from this grants amounting to £210, as well as the Longstaff Honorarium and Medal, had to be paid. That this should be not only possible, but that there should also be an excess of income over expenditure of £26 13*s*. 11*d*. for the year, is due to the amount of £38 6*s*. 11*d*. having been returned from grants made in previous years. In the Transactions for 1906 there are 31 papers contributed by authors to whom grants had been made from the Research Fund.

The Treasurer has great pleasure in recording that in February of the present year the Society received a further munificent donation of £1,000 to the Research Fund from the Worshipful Company of Goldsmiths. The income accruing from this donation will, in accordance with the expressed wish of the donors, be devoted especially to the encouragement of research in metallurgy and inorganic chemistry.

The financial transactions of the Society for the past year have been very satisfactory and show a substantial surplus. The total income of the Society for 1906 is £7,121 8*s*. 11*d*., being an increase of £327 14*s*. 11*d*. over that for 1905 (£6,793 14*s*. 0*d*.), in spite of the fact that the amount received on account of Life Composition Fees has fallen from £360 to £268, a decrease of £92. The increase in income is mainly composed of the following three items: (1) admission fees, £120; (2) annual subscriptions, £138 18*s.* 0*d.*; and (3) sale of publications, £120 6*s.* 3*d.* Whilst the income has notably increased, the expenditure has fallen much more considerably and is £718 19*s.* 8*d.* less than last year, so that instead of a deficit of £305 1*s.* 5*d.* on the year's working there is a surplus of £741 13*s.* 2*d.*, a difference in all of £1,046 14*s.* 7*d.* This is due very largely to having no expenses of any kind to meet on account of the Collective Index, which last year alone cost the Society £778 10*s.* 5*d.*, but it must not be thought that nothing is being done towards the preparation of the next volume, because the card indexes now made by Mrs. Dougal for each Annual Index will, with comparatively little expense and labour, be blended together and thus utilised for the preparation of Vol. V. of the Collective Index, which will cover the period 1903—1912.

The cost of the *Journal*, the *Proceedings*, and the *Annual Reports* all show increased expenditure, amounting to £71 7*s.* 6*d.*, £40 6*s.*, and £68 10*s.* 7*d.* respectively. It is very satisfactory to notice that although the Transactions and Abstracts show an increase of over 200 pages and contain several lengthy, as well as important and expensive, papers, the increase in cost should be so small. In this connexion the Treasurer has to thank Professor Pope and Mr. Barlow for supplying all the blocks required to illustrate their paper published in the November issue of the *Journal*. The increased cost of the Proceedings is due in part to the issue of two additional numbers corresponding to the two extra Meetings of the Society in July and in October, and in part also to the printing of the catalogue, compiled with great care by the Librarian, of the collection of alchemical works above referred to which the Society owes to the generosity of Sir H. E. Roscoe, and which are now properly housed in the Library.

The balance sheet also shows that a small legacy of £33 12*s.* 3*d.* has been received under the will of the late Mr. Henry Dircks, and is a residue of the estate from which almost exactly thirty years ago the Society received £840 5*s.*

The TREASURER gave a statement as to the Society's Income and Expenditure during the year 1906, and proposed a vote of thanks to the Auditors, which was seconded by Dr. W. R. E. Hodgkinson and carried unanimously. Acknowledgment was made by Mr. E. Grant Hooper.

A vote of thanks to the Treasurer, Secretaries, Foreign Secretary, and Council for their services during the past year was proposed by Sir William H. Perkin, seconded by Dr. E. Divers, and adopted unanimously; this was acknowledged by Sir William Ramsay.

The President then delivered his address, entitled "The Position and Prospects of Chemical Research in Great Britain." Dr. T. E. Thorpe proposed a vote of thanks to the President coupled with the request that he would allow it to be printed in the Society's *Transactions.* The motion was seconded by Prof. J. Millar Thomson, and carried with acclamation, the President making acknowledgment.

The Scrutators then presented their report to the Chairman, who declared that the following had been duly elected as Officers and Council for the ensuing year :

President : Sir William Ramsay, K.C.B., F.R.S.

Vice-Presidents who have filled the Office of President : H. E. Armstrong, Ph.D., LL.D., F.R.S. ; A. Crum Brown, D.Sc., LL.D., F.R.S. ; Sir William Crookes, D.Sc., F.R.S. ; Sir James Dewar, M.A., LL.D., F.R.S. ; A. Vernon Harcourt, M.A., D.C.L., F.R.S. ; Raphael Meldola, F.R.S. ; H. Müller, Ph.D., LL.D., F.R.S. ; W. Odling, M.A., M.B., F.R.S. ; Sir W. H. Perkin, Ph.D., LL.D., F.R.S. ; J. Emerson Reynolds, Sc.D., M.D., F.R.S. ; Sir Henry E. Roscoe, LL.D., F.R.S. ; W. J. Russell, Ph.D., F.R.S. ; T. E. Thorpe, C.B., LL.D., F.R.S. ; W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents : J. J. Dobbie, M.A., D.Sc., F.R.S. ; Rudolph Messel, Ph.D. ; Sir Alexander Pedler, C.I.E., F.R.S. ; W. H. Perkin, Ph.D., F.R.S. ; A. Smithells, B.Sc., F.R.S. ; W. P. Wynne, D.Sc., F.R.S.

Treasurer : Alexander Scott, M.A., D.Sc., F.R.S.

Secretaries : M. O. Forster, D.Sc., Ph.D., F.R.S. ; A. W. Crossley, D.Sc., Ph.D.

Foreign Secretary : Horace T. Brown, LL.D., F.R.S.

Ordinary Members of Council : Edward C. C. Baly ; George T. Beilby, F.R.S. ; Bernard Dyer, D.Sc. ; W. R. E. Hodgkinson, Ph.D. ; E. Grant Hooper ; H. A. D. Jowett, D.Sc. ; H. R. Le Sueur, D.Sc. ; F. E. Matthews, Ph.D. ; G. T. Moody, D.Sc. ; A. G. Perkin, F.R.S. ; W. J. Sell, D.Sc., F.R.S. ; John Wade, D.Sc.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society was held at the Whitehall Rooms on Friday, March 22nd, at 7 p.m., at which the following Fellows and Guests were present:

Armit, Dr. H.
Armstrong, Dr. E. F.
Armstrong, Prof. H. E., F.R.S., *Past President.*
Baker, Dr. H. B., F.R.S.
Baker, Mr. J. L.
Barger, Dr. G.
Barry, Sir John Wolfe, K.C.B., F.R.S., *Chairman of Executive Committee, City and Guilds of London Institute.*
Bayliss, Dr. W. M., F.R.S.
Beale, Mr. W. P., K.C., M.P.
Beilby, Mr. G. T., F.R.S.
Blaikie, Mr. L.
Brewin, Mr. A., *Prime Warden, The Dyers' Company.*
Briggs, Mr. H.
Brown, Prof. A. J.
Brown, Dr. H. T., F.R.S., *Vice-President, and Foreign Secretary-elect.*
Brunton, Sir T. Lauder, F.R.S.
Cain, Dr. J. C., *Editor.*
Carpmael, Mr. W.
Carr, Mr. S. E., *Assistant Secretary.*
Carvalho, Mr. S. N.
Chapman, Mr. A. C.
Clark, Dr. John, *President, The Society of Public Analysts.*
Clifford, Mr. F. W., *Librarian.*
Clowes, Prof. F.
Coburn, Mr. H. I.
Cockburn, Hon. Sir John A., K.C.M.G.
Colman, Dr. H. G.
Cooper, Mr. A.
Cooper, Dr. H. C.
Crossley, Prof. A. W., *Hon. Secretary.*
Daily Telegraph, The
Dale, Dr. H. H.
Desch, Dr. C. H., *Assistant Sub-Editor.*
Divers, Prof. E., F.R.S.
Dixon, Prof. H. B., F.R.S., *Vice-President.*
Dixon, Prof. W. E.
Dobbie, Prof. J. J., F.R.S., *Vice-President-elect.*
Dyer, Dr. B.
Elliott, Sir T. H., K.C.B., *Secretary, The Board of Agriculture.*
Elliott, Mr. T. R.
Ewing, Prof. J. A., F.R.S., *Director of Naval Education.*
Fairley, Mr. T.
Farmer, Prof. J. B., F.R.S.
Feilmann, Dr. M. E.
Fenton, Dr. H. J. H., F.R.S.
Fierz, Dr. H. E.
Finzi, Mr. J. A.
Fischer, Geh. Rath Prof. Dr. E., F.R.S.
Fisk, Mr. F. M.
Forbes, Mr. F. A.
Forster, Dr. M. O., F.R.S., *Hon. Secretary.*
Friswell, Mr. R. J.
Gabriel, Geh. Rath Prof. Dr. S.
Gardner, Mr. H. C. T.
Geikie, Sir A., F.R.S., *President, The Geological Society.*
Gibbons, Mr. W. M.
Glazebrook, Dr. R. T., F.R.S., *President, The Institution of Electrical Engineers.*
Green, Prof. A. G.
Greenaway, Mr. A. J., *Sub-Editor.*
Greenish, Prof. H. G.
Hall, Mr. S.
Hall, Mr. S. G.
Harden, Dr. A.
Hardy, Mr. W. B., F.R.S.
Harrison, Prof. J. B., C.M.G.
Harvey, Dr. J. S.
Henry, Dr. T. A.
Hewitt, Dr. J. T.
Heycock, Mr. C. T., F.R.S.
Hill, Mr. C. A.
Hodgkinson, Prof. W. R. E.
Holloway, Mr. G. T.
Hooper, Mr. E. G.
Hopkins, Dr. F. G., F.R.S.
Humphrey, Mr. J.
Jones, Dr. H. O.
Jowett, Dr. H. A. D.
Kelvin, Rt. Hon. Lord, O.M., G.C.V.O., F.R.S.
Kemp, Mr. W. J.
Kipping, Prof. F. S., F.R.S.
Lankester, Prof. E. Ray, F.R.S., *President, The British Association for the Advancement of Science.*
Lees, Mr. F. H.
Le Sueur, Dr. H. R.
Lewkowitsch, Dr. J.
Lockyer, Sir J. N., K.C.B., F.R.S. *Chairman of Committee, British Science Guild.*
Lowry, Dr. T. M.
Luard, Mr. S. W., *Clerk, The Salters' Company.*
Lunge, Prof. Dr. G.
Maben, Mr. T.

MacEwan, Mr. P.
McGowan, Dr. G.
MacMahon, Major P. A., R.A., F.R.S.
Mander, Mr. G. Le M.
Marsh, Mr. J. E., F.R.S.
Martin, Sir Richard B., Bart., *Prime Warden, The Fishmongers' Company.*
Matthews, Dr. F. E.
Meldola, Prof. R., F.R.S., *The President.*
Messel, Dr. R., *Vice-President.*
Mohr, Dr. B.
Moudy, Mr. E. F.
Moody, Dr. G. T.
Morant, Mr. R. L., C.B., *Permanent Secretary, The Board of Education.*
Morning Post, The
Morrell, Dr. R. S.
Morris, Mr. H., *President, Royal College of Surgeons.*
Moseley, Mr. A., C.M.G.
Moss, Mr. C. C. B.
Müller, Dr. Franz.
Müller, Dr. H., F.R.S., *Past President.*
Nagel, Mr. D. H.
Nathan, Lt.-Col., Sir F. L., R.A., *Superintendent, Royal Gunpowder Factory, Waltham Abbey.*
Ogilvie, Mr. F. G., *Princ. Assist. Secretary, Technology and Higher Education in Science and Art, Board of Education.*
Orton, Prof. K. J. P.
Page, Mr. F. J. M.
Palmer, Sir W., Bart.
Paterson, Mr. J. B.
Pedler, Sir A., C.I.E., F.R.S., *Vice-President-elect.*
Perkin, Prof. A. G., F.R.S.
Perkin, Sir W. H., F.R.S., *Past President.*
Perkin, Prof. W. H., F.R.S. *Vice-President.*
Perry, Prof. J., F.R.S., *President, The Physical Society.*
Phené, Dr. J. S., *Master, The Clothworkers' Company.*
Plimmer, Dr. R. H. A.
Pope, Prof. W. J., F.R.S.
Poulton, Prof. E. B., F.R.S.
Power, Dr. F. B.
Prain, Lt.-Col. D., F.R.S., *Director, Royal Botanic Gardens, Kew.*
Press Association, The
Prideaux, Sir W. S., *Clerk, The Goldsmiths' Company.*
Pugh, Mr. A. J.
Ramsay, Sir W., K.C.B., F.R.S., *Foreign Secretary and President-elect.*
Ransford, Mr. R. B.
Rayleigh, Rt. Hon. Lord, O.M., F.R.S., *President, The Royal Society.*
Rees, Mr. H. P.
Reynolds, Prof. J. E., F.R.S., *Past President.*
Roberts, Sir O., *Clerk, The Clothworkers' Company.*
Rücker, Sir A. W., F.R.S., *Principal, The University of London.*
Ruhemann, Dr. S.
Russell, Dr. W. J., F.R.S., *Past President.*
Ryan, Prof. F.
Salamon, Mr. A. G., *President, Institute of Brewing.*
Samuel, Mr. H., M.P., *Parliamentary Under Secretary of State for the Home Department.*
Scott, Dr. A., F.R.S., *Treasurer.*
Seligman, Dr. R.
Sell, Dr. W. J., F.R.S.
Silberrad, Dr. O.
Smith, Dr. F. H.
Smithells, Prof. A., F.R.S., *Vice-President*
Soper, Mr. A. L.
Spielmann, Mr. M. H., F.S.A.
Spielmann, Mr. P. E.
Standard, The
Starling, Prof. E. H., F.R.S.
Stone, Sir B., M.P.
Streatfeild, Mr. F. H.
Streimer, Mr. E. G.
Strutt, Hon. R. J., F.R.S.
Sutton, Mr. G. F., *Clerk, The Dyers' Company.*
Swan, Sir J. W., F.R.S.
Thompson, Prof. S. P., F.R.S., *Principal, Finsbury Technical College.*
Thomson, Prof. J. M., F.R.S.
Thorpe, Dr. J. F.
Thorpe, Prof. T. E., C.B., F.R.S., *Past President.*
Tilley, Mr. J. W.
Tilley, Mr. V. J.
Times, The
Townshend, Col. G. R.
Tunnicliffe, Prof. F. W.
Tyrer, Mr. T., *President, The Pharmaceutical Conference.*
Vincent, Dr. J. H.
Wade, Dr. J.
Walker, Mr. J. T. A.
Waller, Dr. A.D., F.R.S.
Warren, Mr. T. H., *Vice-Chancellor, The University of Oxford.*
Weizmann, Dr. C.
West, Dr. S.
White, Sir W. H., K.C.B., F.R.S.
Woodcock, Mr. R. C.
Wynne, Prof. W. P., F.R.S., *Vice-President.*
Yarrow, Mr. A. F.
Young, Dr. G.
Zilz, Mr. H.

The following toasts were proposed :

By the President.

1. **His Most Gracious Majesty the King.**

2. **Her Majesty the Queen Alexandra, their Royal Highnesses the Prince and Princess of Wales, and the other Members of the Royal Family.**

By the Right Honourable Lord Rayleigh, O.M., F.R.S.,
President of the Royal Society.

3. **The Chemical Society,** coupled with the name of *The President.*

By Sir William Ramsay, K.C.B., F.R.S.,
President-Elect of the Chemical Society.

4. **Scientific Societies,** coupled with the names of the Right Honourable Lord Kelvin, O.M., G.C.V.O., F.R.S., and Professor E. Ray Lankester, F.R.S., *President of the British Association for the Advancement of Science.*

By Professor Henry E. Armstrong, F.R.S.,
Past President of the Chemical Society.

5. **Education,** associated with the names of Mr. T. H. Warren, *Vice-Chancellor of the University of Oxford;* Sir Arthur W. Rücker, F.R.S., *Principal of the University of London;* and Sir John Wolfe Barry, K.C.B., F.R.S., *Chairman of the Executive Committee of the City and Guilds of London Institute.*

Professor T. E. Thorpe, C.B., F.R.S.,
Past President of the Chemical Society.

6. **The Guests,** coupled with the names of Geh. Rath Professor Dr. Emil Fischer, F.R.S., and Professor J. A. Ewing, F.R.S., *Director of Naval Education.*

After the President had given the Loyal Toasts, The Right Honourable LORD RAYLEIGH, O.M., proposed THE CHEMICAL SOCIETY.

He said the toast would require but little commendation from him in such a company as was assembled. Although most of his time had been given up to the study of physics, he had always taken the keenest interest in their science, and at an early age had served a sort of apprenticeship to it, having managed to burn his fingers rather seriously with phosphorus before he was thirteen. Their science was so extensive and grew with such rapidity that many of its branches were but little known to him. As examples of this growth, he referred to the development of the aniline dye industry, which had become of immense theoretical and practical importance, and to the various branches so intimately connected with the name of Dr. Emil Fischer. In some aspects, chemistry might be regarded as a branch of physics, and only lately he had been looking over those wonderful papers of Willard Gibbs which were still the foundation of that branch of chemical science, and which had recently been collected and republished.

Prof. Meldola was a man of many and varied attainments. Primarily he was a chemist, but there were few departments of science with which he was not connected, and therefore in giving the toast of the Society he would couple with it the name of its President.

The PRESIDENT said he was deeply indebted to those present for the very kind reception which they had given to the toast proposed by the distinguished President of the Royal Society. He could not help feeling that this was one of those rare occasions that fall to the lot of the official representative of one of the scientific societies to speak to a somewhat wider public than his own immediate circle of colleagues who meet within the walls of the scientific societies, and he would take this opportunity of saying a word or two as to the work of these societies. He feared there was only too much truth in the accusation that this is an unscientific nation. Still, he would have it known that in societies like that assembled and in kindred societies there were banded together small armies of ardent workers who were keeping alight the torch of scientific research, and that, however unscientific nationally, when the time of scientific enlightenment arrived he hoped this would count to our credit and for merit. With regard to the Chemical Society in particular, he felt disposed to join issue with Lord Rayleigh as to whether chemistry should be regarded as a branch of physics or physics as a branch of chemistry. He claimed that in its ultimate association with other departments of science, chemistry was as far-reaching, as cosmopolitan, as any branch of science which was being cultivated at the present time. The Chemical Society was in an exceedingly flourishing condition. It was a venerable Society, founded in 1841, and granted a Charter in 1848. It had therefore arrived at what, according to the Civil Service estimates, would be considered as the year of dotage, instead of which he regarded it as only just entering its prime. During the last few months the Society's ranks had been thinned by the hand of death in the most lamentable way. All its honorary and foreign Russian members, Beilstein, Mendeléeff, and Menschutkin, had been lost, and in France Moissan had passed away, and, quite recently, Berthelot. He was sure those assembled would like it to be known how deeply they sympathised with their foreign *confrères* on the international loss which science had sustained by the death of these distinguished chemists. The Society had a membership of nearly 2,900, and was spending from £4,000 to £5,000 a year in printing and publishing the Transactions, Proceedings, and Annual Reports. Of the value of these publications he need say nothing, for they were sufficiently well known, and if any justification for the Society's existence were ever needed its publications might be pointed out as the one great work which it had so successfully carried on. The editorial department was omnivorous. In the pages of the Journal, room was made for atoms and electrons, and even corpuscles. They all received perfectly impartial editorship, and if the new President would forgive the reference, space was even found for organic chemistry! Among the self-imposed duties of the President was the delivery of an annual address, and that afternoon he had been dealing with a subject he had closely in mind, namely, the position of chemical research in this country. He had come to the conclusion that there was an immense deal of chemical talent, of chemical faculty, but that there was an enormous wastage going on all over the country owing to unfavourable conditions, some of which he had endeavoured to analyse in the course of his address. That was a very deplorable state of affairs, for which he saw no immediate prospect of any remedy. He thought gratitude should be expressed for any checks to this wastage that might be in existence, and that it was the duty, not only of the Chemical Society as regards its own science, but the duty of the scientific world as a whole to give recognition to those agencies which were at work, helping to check this wastage of what he and many others considered to be one of the most valuable assets possessed by the country, namely, the original faculty of scientific work. Of such agencies he would mention the 1851 Exhibition Scholarship, the Fellowship given by the Salters' Company, and the Carnegie Scholarships. As to Research funds, the Government made a grant to the Royal Society, but Chemistry could only come in for its share along with other sciences. Then there was the Research Fund of the Chemical Society, from which there accrued the modest income of some £220 per annum, and on account of that income being so modest its allotment had to be limited to workers for the purchase of expensive materials and apparatus. The fund had been augmented recently by the munificence of the Goldsmiths' Company, who had added £1,000 to it. He would take this public opportunity of expressing the appreciation of the whole scientific world at the munificence of this same Company, which had so splendidly endowed the Lawes Agricultural Institute by a gift of £10,000. Then it was hoped that in a short time the sum of £2,700 would be added to the Research Fund of the Chemical Society in the name of a distinguished past-President, Sir W. H. Perkin. Much more could be done if there were greater reserves to fall back upon. It had always been a point of ambition to him to see the Research Fund in such a position as would enable the Society to give personal grants to workers, so that they could each secure the services of competent men to co-operate with them in their work. That point appealed particularly to teachers like himself. All teachers had had brilliant young men passing through their classes who had been compelled to go out into the world as soon as possible to earn their living, and thus the country had practically lost the benefit of their capabilities. If by some such endowment as that alluded to teachers were enabled to capture talent of this kind and keep it going, the chemical research of the country would be an enormous gainer in the long run.

Sir WM. RAMSAY, K.C.B., proposed "Scientific Societies." After mentioning many of the learned Societies of Europe and America, he asked why were they banded together. There were important reasons. One was that the young members were enabled to meet the old, which gave great encouragement to the younger men, and their elders found pleasure in knowing them, but the chief reason was that they all had at heart the advancement of knowledge. They desired to increase the sum total of the knowledge of the phenomena of the world. Their desire to know was insatiable, and they were willing to make sacrifices to that end. In that way they founded a brotherhood with all others who were working like themselves, independent of politics and independent of nationality. For these reasons, he asked them to drink the toast.

LORD KELVIN, O.M., G.C.V.O., was the first to respond. He said he found it very difficult to distinguish between the scientific societies for which he had to reply. He believed "Physics" was the subject for which he was specially responsible. But chemistry—how was it distinguished from physics? For fifty-three years he had endeavoured to teach natural philosophy, which was Scotch for physics, and he never could distinguish between physics and chemistry. Well, what was physics and what was chemistry? He would define them together as the science of Force. They heard much at present of the breaking up of atoms, but when they heard of an object from which something had been chipped, it could not have been an atom. He had read in the newspapers of the death-bed of an atom, and yet chemists were going to be told that there was no such thing as an atom! Whether there were many atoms of a different kind was a matter for investigation, but whether each atom of its own kind remained for ever unchanged or not was a subject much discussed. He was not then going to give an opinion upon it, but it was better not to call a thing an atom when it was broken. As to chemistry, he had great sympathy with it. Lord Rayleigh burnt his fingers with phosphorus when he was thirteen. Well, he (Lord Kelvin) had burnt his fingers with phosphorus when he was eighty-two, a thing but few chemists or physicists could say.

Prof. E. RAY LANKESTER also responded. Scientific societies at the present time were somewhat limited in their objects, or at any rate in their possible activity. He thought they should become something more like the ancient guilds of the great cities of Europe, and endeavour to obtain large funds from those who had benefited and had made fortunes out of the knowledge discovered by the devotees of these sciences, and to employ those funds in development on their own particular lines. He was astonished to learn that the Chemical Society had a Research Fund that produced only £220 a year. When they heard of the large fortunes made by the application of chemistry, he felt that one reason why they did not get more was some want of organisation to enable the societies to secure a very much larger proportion of the wealth gained from the increase of scientific knowledge. In the future he thought they should try to make one large scientific society, something like a guild, or ancient college, or brotherhood, which would hold property for the benefit of a great cause. He ventured to say that would be a much better way to advance science than by gifts of money to mixed corporations, such as universities. He had no faith in universities as promoters of scientific knowledge. Judging from the use made of the funds of the University of Oxford, no one could say that it was desirable to entrust any large sum of money, at the present moment, at any rate, to that University for the promotion of scientific research. The same would apply to the University of London. But societies, such as he suggested, could apply such funds without any danger of their being perverted to secondary uses.

Prof. HENRY E. ARMSTRONG proposed the toast of "Education." Speaking of the Universities, he said a head and centre was absolutely necessary for classical activity, but they could not but feel that it was the duty of the Universities to exact from their sons also some understanding of science. Some knowledge of experimental phenomena should be aimed at in all culture.

Mr. T. H. WARREN responded first. He said that chemistry at Oxford was not what it ought to be, but its position was far different from that which it occupied some years ago. The universities were reviving the traditions of olden times. At Oxford there was a great school of chemistry and there were many young chemists there who would be heard of before long.

Sir ARTHUR W. RÜCKER next responded. He said it was the duty of a University to teach and to add to knowledge, and he confessed to receiving a shock at what Prof. Ray Lankester had said. He stoutly defended the University of London, and added that after all education was growing and we need not despair of English education.

Sir JOHN WOLFE BARRY also responded. He said he looked forward to great results from the Colleges at South Kensington. Speaking as an engineer, he thought his profession might be stated to rest upon chemistry, which taught them the composition and properties of materials. Civil engineers were deeply indebted to the Chemical Society.

Prof. THOMAS EDWARD THORPE proposed "The Guests."

Dr. EMIL FISCHER and Prof. J. A. EWING responded.

Thursday, April 18th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. W. S. Anderson and L. R. Scammel were formally admitted Fellows of the Society.

It was announced that the Council had appointed the following Committees for 1907—1908.

Finance Committee.—E. G. Hooper, G. T. Moody, T. E. Thorpe, W. A. Tilden, and the Officers.

House Committee.—W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. M. Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

Library Committee.—E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. M. Thomson (*Chairman*), J. Voelcker, J. Wade, the Editor, and the Officers.

Publication Committee.—H. E. Armstrong, E. C. C. Baly, W. R, Dunstan, R. Meldola, G. T. Morgan, W. A. Tilden, J. Wade, and the Officers.

Research Fund Committee.—G. T. Beilby, W. R. Dunstan, P. F. Frankland, A. D. Hall, G. Matthey, R. Messel, H. Müller, Sir A. Pedler, W. H. Perkin, W. A. Tilden, and the Officers.

Certificates were read for the first time in favour of Messrs. :

Hugh Hague Copping, B.A., Cabourne, Caistor, Lincolnshire.
Matthewman Dalton Cowap, 21, Alma Square, St. John's Wood, N.W.
Eugen Fischer, Ph.D., Biebrich am Rhein, Germany.
Walter George Gledhill, M.A., Dersingham, Greenroyde, Halifax.
John Atkinson Jennings, 61, Gleneagle Road, Streatham, S.W.
Percival George Lloyd, 15, Woodside Road, Kingston-on-Thames.
Harold Pochin, B.A., 12, Chapel Street, Berkhampstead, Herts.
Charles Kenneth Tinkler, B.Sc., 297, Franklin Road, Kings Norton, Nr. Birmingham.

A certificate has been authorised by the Council for presentation for ballot under Bye-law I (par. 3) in favour of Mr. Thomas Kirkman Dealy, Craigmin East, Magazine Gap, Hongkong.

Of the following papers, those marked * were read :

*76. "The magnetic rotation of hexatriene, $CH_2\colon CH\cdot CH\colon CH\cdot CH\colon CH_2$, and its relationship to benzene and other aromatic compounds, also its refractive power." By Sir William Henry Perkin.

In a paper on the magnetic rotatory power of aromatic compounds (*Trans.*, 1896, 69, 1025) the very high rotations they possess have been pointed out; the cause of this has been supposed to be due in the case of benzene to its ring formation, because the rotation of that substance is much higher than that of its isomeride dipropargyl.

This, however, became doubtful when it was found that d-$\Delta^{3:8(9)}$-p-menthadiene, which contains two unsaturated groupings in conjunction, gave abnormally high rotations, indicating the possibility that in benzene and other substances containing unsaturated groups in conjunction, the high rotations were also due to this circumstance. It was therefore desirable to examine some chain compound containing unsaturated groups in conjunction, in which there could be no influence due to ring formation. This was rendered possible by the examination of hexatriene, which contains three consecutive unsaturated groups.

Hexatriene was found to have a remarkably high rotation of 12·196. The difference in the formation of hexatriene and benzene is simply the difference of ring formation, due to the loss of 2 atoms of hydrogen. This affects the magnetic rotation by 0·982 and if that amount is subtracted from the above a value is obtained for the magnetic rotation of benzene, based on the assumption that benzene contains three unsaturated groupings; this amounts to 11·214.

This number is practically that actually found for benzene, 11·284, and appears to point to two conclusions, namely, that benzene contains three contiguous unsaturated groupings (Kekulé's formula), and secondly that these have substantially the same values as in open chain compounds.

It is also noticed that the values of these unsaturated groups when in conjunction considerably increase with their number.

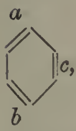
The refractive and dispersive power of hexatriene is very high, but the numbers do not show such a close relationship to benzene as do the magnetic rotations.

DISCUSSION.

Mr. S. S. PICKLES stated that the results obtained by Sir W. Perkin were of interest particularly to terpene chemists, who were frequently coming in contact with phenomena connected with systems of conjugated ethylenic linkings. The anomalous behaviour of compounds containing such an arrangement of double bonds called for some explanation. The fact that such compounds as phellandrene, $\Delta^{3:8(9)}$-*p*-menthadiene, and $\Delta^{1\cdot 3}$-dihydrobenzene, all of which contain the grouping $\cdot C\vdots C\cdot C\vdots C\cdot$, combine with only two atoms of bromine additively, instead of with four as might be expected, and the persistence of the remaining condition of unsaturation had often led chemists to wonder what was the state of affairs in conjugated ethylenic linkings. Sir W. Perkin's determinations had shown that from a physical standpoint there were reasons for assuming a somewhat similar condition to that prevailing in the benzene ring, and the speaker considered that the above-mentioned behaviour was to some extent chemical evidence in the same direction.

Thus, accepting certain properties and behaviour as the outcome of this arrangement of double bonds, the Kekulé formula becomes applicable and explanatory in the case of benzene.

Mr. BALY pointed out that in the Kekulé benzene formula



, the conjugation of double linkings is greater than in hexatriene; in benzene this effect occurs between the double linkings *a* and *b*, between *b* and *c*, and between *c* and *a*, whilst in hexatriene, $CH_2\overset{a}{\vdots}CH\cdot CH\overset{b}{\vdots}CH\cdot CH\overset{c}{\vdots}CH_2$, the effect only occurs between *a* and *b* and between *b* and *c*, and not between *c* and *a*. He asked whether this increased conjugation might not be the origin of the fact that the magnetic rotation of benzene is higher than that of hexatriene by

0·07. He did not agree with Professor Armstrong's remarks that Sir William Perkin's results do not fit in with the modern views of the benzene molecule. The three double linkings as required by the Kekulé formula give rise to a definite amount of conjugation between them, and hence to a definite magnetic rotation. If the ring be flexible and in a state of pulsation or vibration, the total amount of conjugation would remain the same, as no energy leaves or enters the system. The magnetic rotation would therefore be the same as that demanded by the three static double linkings.

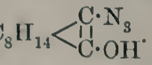
The PRESIDENT remarked that the fact that Sir W. Perkin had found results which proved that the Kekulé formula for benzene is the "true" one might be interpreted as implying that the Kekulé formula is the mean of the various possible formulæ for benzene, configurations which it undoubtedly assumes during its changes.

Sir W. H. PERKIN, in reply, said that it was well to bear in mind that the difference in rotation between the chain compounds hexatriene and hexane was practically the same as that existing between the ring compounds benzene and hexamethylene. That the two classes of compounds should possess different chemical properties did not seem surprising.

The difference of 0·07 between the rotation of benzene estimated from hexatriene and the found value was small and might partly be due to experimental error; it had therefore not been thought advisable to give any special significance to it in the meantime.

*77. "Aromatic azoimides. Part I. *p*-Hydroxyphenylazoimide."

By Martin Onslow Forster and Hans Eduard Fierz.

The properties of camphorylazoimide have led the authors to investigate those of aromatic hydroxy-derivatives containing the N_3-nucleus in order to ascertain whether the behaviour of the first-named substance is not best explained by the constitutional formula  $C_8H_{14}<\begin{matrix}C\cdot N_3\\ \| \\ C\cdot OH\end{matrix}$.

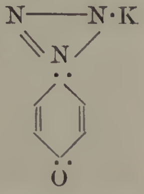
p-*Hydroxyphenylazoimide*, $HO\cdot C_6H_4\cdot N_3$, prepared by the action of hydroxylamine on diazotised *p*-aminophenol, is a colourless oil which has not been solidified, as an attempt to purify it by distillation under 1 mm. resulted in an explosion at 150°. The *benzoyl* derivative melts at 80°, and the *potassium* derivative has been obtained in two forms, coloured and colourless. The m-*nitrobenzoyl* derivative is faintly yellow and melts at 118°.

Nitrous acid converts *p*-hydroxyphenylazoimide into 3-*nitro*-4-*hydroxyphenylazoimide*, $C_6H_4O_3N_4$, a volatile, orange-coloured compound melting at 91°; the *benzoyl* derivative is colourless and melts at 103°.

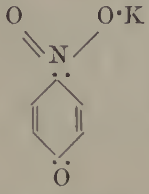
DISCUSSION.

Prof. MELDOLA asked whether the identity of the benzoyl derivatives prepared, on the one hand, by benzoylating the azoimide obtained by the author's method, and, on the other, from *p*-nitrophenyl benzoate by reduction, diazotisation, and conversion into the azoimide by the usual method, did not indicate that the compound possessed the phenolic as distinguished from the quinonoid constitution.

Dr. MORGAN enquired whether the authors recognised any analogy between the isomeric potassium derivatives of their *p*-hydroxyazoimide and the two series of ethers obtained by Hantzsch and his collaborators from the nitrophenols. If such a comparison were valid the alternative formula I for the coloured potassium salt:



(I.)



(II.)

would indicate clearly the relationship existing between this salt and the coloured ether (formula II) of *p*-nitrophenol.

In reply to Professor Meldola, Dr. FORSTER stated that the benzoyl derivative of *p*-hydroxyphenylazoimide obtained from *p*-nitrophenol was slightly coloured, as indeed were most of the specimens obtained from the colourless potassium derivative of the azoimide compound, but the appearance of such specimens was quite distinct from that of the benzoyl derivative obtained from the blue salt of *p*-hydroxyphenylazoimide. He regarded Dr. Morgan's suggestion as an acceptable one, and stated that the bearing of Hantzsch's work upon the problem had been appreciated in the paper.

*78. "Measurements of the velocities of saponification of the *l*-menthyl and *l*-bornyl esters of the stereoisomeric mandelic acids." By Alexander McKenzie and Herbert Bryan Thompson.

The authors find that *l*-bornyl *d*-mandelate is saponified more quickly than is *l*-bornyl *l*-mandelate. The esters were prepared from *d*- and *l*-mandelic acids respectively, and their velocities of saponification measured in ethyl-alcoholic solution under varying conditions of concentration and temperature.

l-Menthyl *d*-mandelate and *l*-menthyl *l*-mandelate (*Trans.*, 1904, 85,

1249) were also examined from the same standpoint; it was found that the former ester is the more readily saponifiable of the two.

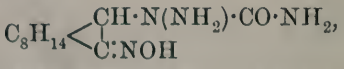
A comparison of the velocities of saponification of the bornyl and menthyl esters shows that the former are much more quickly saponified than the latter (compare also *Trans.*, 1904, **85**, 378; 1905, **87**, 1004).

*79. "The constituents of the essential oil of American pennyroyal. Occurrence of a dextro-menthone." By Marmaduke Barrowcliff.

The oil used in this investigation possessed the following characters: $d15°/15° = 0·9297$; α^{22}_{D} +25°44′ in a 1-dcm. tube; soluble in twice its volume of 70 per cent. alcohol. It has been found to consist of: (1) an undetermined phenol, in very small amount; (2) *l*-pinene (nitrosochloride, m. p. 103—104°; nitrolbenzylamine, m. p. 122°); (3) *l*-limonene (tetrabromide, m. p. 104°); (4) dipentene (tetrabromide, m. p. 124°), all of those terpenes being present in only small amount; (5) 1-methyl-3-*cyclo*hexanone (oxime, m. p. 41—43°; semicarbazone, m. p. 182—183°), about 8 per cent.; (6) pulegone (semicarbazone, m. p. 171°), about 30 per cent.; (7) *l*-menthone (oxime, m. p. 58—59°; semicarbazone, m. p. 184—186°), and (8) *d*-iso*menthone* (semicarbazone, m. p. 125—126°), identical with the dextrorotatory constituent of Beckmann's "inverted menthone"; the amount of these two menthones constituting about 50 per cent. of the oil; (9) a sesquiterpene alcohol, about 2 per cent.; (10) esters of formic, acetic, octoic, decylic, and salicylic acids, and the ester of a dibasic acid of the probable formula $C_8H_{14}O_4$, together with formic, butyric, octoic, and decylic acids in the free state; all these esters and acids being present only in small amount.

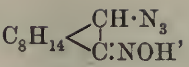
80. "Studies in the camphane series. Part XXIII. Oximes of camphorylsemicarbazide and camphorylazoimide." By Martin Onslow Forster and Hans Eduard Fierz.

The *oxime* of *camphorylsemicarbazide*,

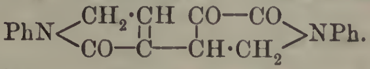


$C_8H_{14}<\begin{matrix}CH\cdot N(NH_2)\cdot CO\cdot NH_2,\\ |\\ C:NOH\end{matrix}$

obtained from camphoryl-ψ-semicarbazide and hydroxylamine acetate, crystallises in lustrous, hexagonal plates, melts at 242°, and has $[\alpha]_D$ 105·4° in glacial acetic acid; an isomeric *oxime*, $C_{11}H_{20}O_2N_4$, produced by the action of cold dilute sulphuric acid on the foregoing substance, crystallises in lustrous needles, has $[\alpha]_D$ −37·7° in pyridine, and melts at 222°. The *benzylidene* compound, $C_{18}H_{24}O_2N_4$, the m-*nitrobenzylidene* compound, $C_{18}H_{23}O_4N_5$, and the *furfurylidene* compound, $C_{16}H_{22}O_3N_4$, melt at 205°, 215°, and 225° respectively.

The *oxime* of *camphorylazoimide*,  $C_8H_{14}<\begin{matrix}CH\cdot N_3\\ |\\ C{:}NOH\end{matrix}$, melts at 84°, and, unlike camphorylazoimide itself, resists the action of cold alcoholic potash; on heating with this agent, hydrazoic acid is eliminated instead of nitrogen.

81. "The action of ethyl oxalate on thioacetanilide and its homologues." By Siegfried Ruhemann.

Homologues of dithioxanthoxalanil have been obtained by the action of sodium ethoxide and ethyl oxalate on the thioaceto-derivatives of *p*-toluidine, *m*-xylidine, and *β*-naphthylamine respectively. With caustic potash, they behave like dithioxanthoxalanil. The action of zinc dust and acetic acid on these compounds is unlike the behaviour of the reducing agent towards xanthoxalanil and its homologues which absorb six atoms of hydrogen (Ruhemann, *Trans.*, 1906, 89, 1851) and yield colourless substances, whereas dithioxanthoxalanil is transformed into $C_{20}H_{16}O_3N_2$ (grey, shiny plates which decompose at about 240°). In this case, therefore, no addition of hydrogen takes place, but the whole of the sulphur is substituted by hydrogen; the following constitutional formula is therefore suggested for the compound:  $PhN<\begin{matrix}CH_2\cdot CH & CO-CO\\ \| & |\\ CO-C & CH\cdot CH_2\end{matrix}>NPh$. The substance, when digested with alkalis or alkali carbonates, yields blue salts of a red compound which has not yet been carefully examined, but is probably isomeric with the reduction product, $C_{20}H_{16}O_3N_2$, of dithioxanthoxalanil. This phenomenon resembles the transformation of the yellow product of the reaction between acetylacetone and phenylpropiolyl chloride into its red isomeride, which also yields blue salts (see Ruhemann and Merriman, *Trans.*, 1905, 87, 1383).

82. "The action of tribromopropane on the sodium derivative of ethyl acetoacetate." By Thomas Edward Gardner and William Henry Perkin, jun.

When tribromopropane reacts with the sodium derivative of ethylacetoacetate the principal product is *ethyl γ-bromoallylacetoacetate*, $CH_2{:}CBr\cdot CH_2\cdot CH(COMe)CO_2Et$, which distils at 120° (8 mm.) and, when hydrolysed with alcoholic potash, yields *$\Delta\gamma$-butinene-α-carboxylic acid*, $CH{⋮}C\cdot CH_2\cdot CH_2\cdot CO_2H$ (m. p. 55—57°). Hydrolysis with dilute sulphuric acid converts ethyl γ-bromoallylacetoacetate into *γ-bromoallylacetone*, $CH_2{:}CBr\cdot CH_2\cdot CH_2\cdot COMe$, which distils at 83° (8 mm.), yields a liquid *oxime* and a crystalline *semicarbazone* (m. p. 150°), and when reduced with sodium and alcohol is converted into 2-*hydroxy*-5-*hexene* (methylcrotonylcarbinol),

$$CH_2{:}CH{\cdot}CH_2{\cdot}CH(OH)Me.$$

Alcoholic potash hydrolyses γ-bromoallylacetone with elimination of hydrogen bromide and formation of Δ^{γ}-*butinene methyl ketone*,

$$CH{\vdots}C{\cdot}CH_2{\cdot}CH_2{\cdot}COMe.$$

This ketone distils at 149° (749 mm.), yields an *oxime* (m. p. 48°) and a *semicarbazone* (m. p. 136°), and gives a yellow precipitate of the copper derivative when its aqueous solution is mixed with ammoniacal cuprous chloride.

The sodium derivative of ethyl methylacetoacetate reacts readily with tribromopropane, and the *ethyl methyl-γ-bromoallylacetoacetate*, $CH_2{:}CBr{\cdot}CH_2{\cdot}CMe(COMe)CO_2Et$, thus produced, yields Δ^{δ}-*pentinene-β-carboxylic acid*, $CH{\vdots}C{\cdot}CH_2{\cdot}CHMe{\cdot}CO_2H$ (b. p. 207°), when it is hydrolysed with alcoholic potash.

Ethyl γγ-dibromodiallylacetoacetate, $(CH_2{:}CBr{\cdot}CH_2)_2C(COMe){\cdot}CO_2Et$, is produced in small quantity when tribromopropane is digested with the sodium derivative of ethyl acetoacetate. It is a viscid oil which distils at 175—180° (8 mm.), and is hydrolysed by alcoholic potash with formation of $\Delta^{\alpha\xi}$-*heptadi-inene-δ-carboxylic acid*,

$$(CH{\vdots}C{\cdot}CH_2)_2CH{\cdot}CO_2H.$$

This acid melts at 48° and is converted by boiling with water into *m*-toluic acid (compare *Proc.*, 1906, **22**, 133).

83. "Indican. Preliminary notice." By Arthur George Perkin and William Popplewell Bloxam.

Indican, first described by Schunck (*Phil. Mag.*, [iv], **10**, 74, 1855, and *ibid.*, **15**, 122, 1858), has recently (*Proc. K. Akad. Wetensch. Amsterdam*, 1900, **2**, 520) been shown by Hoogewerff and Ter Meulen to be a well-defined, crystalline substance. As the result of experience gained by a study of the process of the latter chemists, the authors have devised a comparatively simple method for the isolation of this glucoside, by which a largely increased yield of the compound is obtained. The air-dried leaves of the *Indigofera Sumatrana* are extracted with acetone, the extract partially evaporated, and diluted with light petroleum which precipitates impure indican as a syrup; this after treatment with water is filtered, and the filtrate on concentration in a vacuum deposits the glucoside in a crystalline condition. The yield approximates to about 50 per cent. of that extracted by the acetone, although certain precautions are necessary. This process can be carried out entirely in the cold, and the contention of Schunck (*Chem. News*, 1900, **82**, 176) that his compound was distinct from the crystalline variety is thus evidently untenable. Experiments by Hoogewerff and Ter Meulen's method (*a*) and the acetone process (*b*) have shown that the leaves of *Indigofera arrecta* also contain the same indican, but in this case the preparation is more troublesome owing partly to the presence of kaempferitrin (*Proc.*, 1906, **22**, 130), but more especially to that of a colourless, sugar-like compound, m. p. 186—187°, deposited in prisms from its alcoholic solution by means of ether. It resembles dulcite, but probably has the formula $C_6H_{12}O_5$ (found, C = 43·56; H = 7·44). Numerous air-dried preparations of indican melted at 57—58°, and samples obtained through the kindness of Prof. van Romburgh of Utrecht, and Prof. Beyerinck of Delft had also this property, so that the m. p. 51° of Hoogewerff and Ter Meulen may be a clerical error. When dried in a vacuum, indican fuses at about 100—101°, as stated by these chemists, but this appears to be due to the presence of water, for on further heating resolidification ensues, the product finally melting at 176—177°. Analysis of indican dried at 100° was in agreement with the formula $C_{14}H_{17}O_6N$ (H and t. M) (found, C = 56·83; H = 5·83), and when dried in a vacuum and allowed to regain a constant weight in moist air the figures approximated to $C_{14}H_{17}O_6N,2\frac{1}{2}H_2O$ (found, C = 49·89; H = 6·67; N = 4·38; H_2O = 13·80).

84. "Cupric nitrite." By Prafulla Chandra Rây.

A dilute solution of cupric nitrite slowly absorbs oxygen from the air and is converted into nitrate, following the law of mass-action. When a concentrated solution of cupric nitrite, however, is evaporated over sulphuric acid, even under diminished pressure, it partially decomposes according to the equation, $3Cu(NO_2)_2 = Cu(NO_3)_2 + 2CuO + 4NO$. The formula assigned to basic nitrite of copper by Hampe is untenable.

85. "The action of hydrogen peroxide on potassium cyanide." By Orme Masson.

The author finds that (1) hydrogen peroxide and potassium cyanide react exothermically in aqueous solution at the ordinary temperature.

(2) The peroxide is reduced without escape of oxygen so long as residual cyanide is present, but any excess of peroxide is afterwards decomposed into water and oxygen.

(3) The products of the oxidation of the cyanide, which do not include oxamide or oxalate, are potassium cyanate and potassium and ammonium carbonates. Cyanate is the primary product and tends to be converted by hydrolysis into carbonate through the catalytic agency of the peroxide.

(4) A part of the cyanide is converted by hydrolysis, without oxidation, into potassium formate and ammonia.

(5) The total oxidation product (cyanate plus carbonate) accounts for about four-fifths of the original cyanide, and the hydrolysis product (formate) for about one-fifth.

(6) The curve representing the progress of the reduction of peroxide, so long as unchanged cyanide remains, is of the second order and accords with the equation $\frac{dx}{dt}=k(A-x)\ (B-x)$, where A is the initial concentration of the peroxide, B that of the cyanide, and x the measure of the peroxide reduced, or cyanide oxidised, at time t. $B-x$ is the sum of the residual cyanide $(B-y)$ and its hydrolysed product (w).

(7) The hydrolysed product (w) reaches its maximum and final value ($W=0{\cdot}2B$, nearly) before the completion of the oxidising action, and thereafter the slopes of the peroxide and cyanide curves are equal. The rate of hydrolysis is expressed by the empirical rule that $\frac{dw}{dt}=k_1(A-x)\ (W-w)$.

(8) If the solutions contain at the outset the ultimate products of the action itself, as well as fresh cyanide and peroxide, these products do not exert the influence indicated by the above equations. Hence some unknown intermediate condition probably occurs while the action is in progress.

(9) The addition of caustic potash or sulphuric acid at the outset greatly retards the whole action, but the addition of ammonia has very little effect.

86. "The reaction between calcium carbonate and chlorine water." By Arthur Richardson.

The author finds that cold chlorine water decomposes calcium carbonate with formation of calcium chloride and hypochlorous acid until 1 part of carbonate is dissolved in 30 parts of water, as shown by Williamson; $CaCO_3+2Cl_2+H_2O=CaCl_2+2HClO+CO_2$. At a later stage, calcium chloride, chlorate, and hypochlorite are formed, together with hypochlorous acid. This process goes on until from 40 to 50 per cent. of calcium chloride is obtained; beyond this point calcium carbonate is insoluble in chlorine water.

When chlorine water containing calcium carbonate in suspension is heated, oxygen is evolved and calcium chloride and chlorate are formed. In this case also, hypochlorous acid appears to be first produced, a part being then oxidised to calcium chlorate, another part reduced to chloride, and a third part further reduced to free chlorine, whilst the hydrogen and part of the oxygen combine to form water, and the remainder of the oxygen is liberated.

87. "The density of hydrogen chloride." By Robert Whytlaw Gray.

Guye and Ter-Gazarian (*Compt. rend.*, 1906, **143**, 1233) have recently redetermined the density of this gas, and have calculated by means of it the physical atomic weight of chlorine. Some months ago the author made a series of weighings with the same object in view, but the results did not exhibit as good an agreement with each other as had been expected, and hence publication was deferred. At the request of Professor Guye, the results of the first series of measurements are now communicated. The gas was evolved by the action of pure concentrated sulphuric acid on pure solid sodium chloride in a vacuum, and was purified by fractional distillation at a low temperature. Six experiments were made. The highest value obtained for the weight of a litre of the gas at 0° and 760 mm. in London was 1·64091 grams, and the lowest 1·64026 grams. The mean value, corrected to lat. 45, is 1·6397 grams, which is practically identical with the value 1·6398 grams found by Prof. Guye.

88. "Di-iodocamphor." By James Ernest Marsh and Robert de Jersey Fleming Struthers.

In a former paper (*Trans.*, 1905, **87**, 1882), the authors stated that alkaline mercury cyanide did not form a derivative with camphor similar to that which it gives with certain other ketones. When, however, camphor is acted on by an alkaline solution of mercuric iodide containing potassium iodide, a *mercury* derivative of camphor is obtained. This substance is insoluble in water, but soluble in alcohol, and when treated with iodine gives mercuric iodide and *di-iodocamphor*. The latter substance forms brittle, yellow crystals melting at 108°, and soluble in alcohol, benzene, chloroform, or light petroleum. Its solution in chloroform is dextrorotatory. It is stable in the crystalline form, but its solution is decomposed by the action of light with separation of iodine.

89. "Acyl-ψ-derivatives of iminothiolcarbamic acid and their isomerides." By Augustus Edward Dixon and John Taylor.

The authors have made a further study of the additive compounds produced from acylogens and thioureas, and of the migration of acyl groups within the resultant molecules (Dixon and Hawthorne, *Trans.*, 1907, **91**, 122).

Ethyl chlorocarbonate unites with phenylthiourea, yielding the hydrochloride of a feeble *base*, $NH{:}C(NHPh){\cdot}S{\cdot}CO_2Et$, carbethoxylic iminophenylthiolcarbamide (otherwise, carbethoxy-ψ-phenylthiourea), which gives a *picrate.* When liberated from its hydrochloride, the base rapidly undergoes intramolecular change, the carbethoxy-radicle exchanging places with the hydrogen of the phenylamino-group, and thus furnishing the isomeric *aa*-carbethoxyphenylthiocarbamide, $CO_2Et{\cdot}NPh{\cdot}CS{\cdot}NH_2$, m. p. 133°. The hydrochlorides from *o*- and *p*-tolylthioureas yield *aa*-homologues, melting at 150° and 149° respectively.

Aryl chlorocarbonates also unite with aryl-monosubstituted thioureas; the products, on withdrawal of the halogen acid, yielding *aa*-disubstituted thiocarbamides, for example, $CO_2Ph{\cdot}NPh{\cdot}CS{\cdot}NH_2$.

Toluoyl chloride unites with thiourea and with phenylthiourea ; the hydrochloride, $NH{:}C(NHPh){\cdot}S{\cdot}CO{\cdot}CH_2Ph,HCl$, m. p. 131°, gives on treatment with calcium carbonate and alcohol the compound,

$$CH_2Ph{\cdot}CO{\cdot}NPh{\cdot}CS{\cdot}NH_2,$$

m. p. 114° (corr.), isomeric with the base; when melted, it undergoes further intramolecular change into another isomeride,

$$CH_2Ph{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NHPh,$$

m. p. 110°.

Attempts to isolate *aa*-benzoylphenylthiocarbamide failed, owing to the readiness with which the *ab*-form is produced. Palmityl chloride unites with thiourea and with phenylthiourea; from the latter combination, by withdrawal of the combined hydrochloric acid, *aa*-palmitylphenylthiocarbamide may be obtained.

Phenylbenzylcarbamic chloride, $CH_2Ph{\cdot}NPh{\cdot}COCl$, does not appear to yield a hydrochloride with phenylthiourea, the mixture, when warmed, decomposing with formation of benzylaniline and evolution of carbonyl sulphide.

Every *aa*-disubstituted monoacyl thiocarbamide so far examined gives thiocyanic acid when treated with strong caustic alkali ; the supposed bases, $NH{:}C(NHPh){\cdot}S{\cdot}CO_2Me$, &c. (Dixon, *Trans.*, 1903, **83**, 550), respond to this test, and hence must be regarded as *aa*-thiocarbamides.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Abegg, *Richard.* The electrolytic dissociation theory. Authorised translation by *Carl L. von* Ende. pp. vii + 180. New York. (*Recd.* 12/4/7.) From the Publishers: Messrs John Wiley and Sons.

American Electrochemical Society. Transactions. Vol. X. Philadelphia 1906. (*Reference.*) From Dr. F. Mollwo Perkin.

Berthelot, *Marcellin.* Traité pratique de l'analyse des gaz. pp. ix + 483. ill. Paris 1906. (*Recd.* 13/4/7.) From the Author.

Clowes, *Frank,* and **Coleman**, *J. Bernard.* Elementary practical chemistry. Part I. General chemistry. Part II. Analytical chemistry. Fifth edition. 2 vols. pp. xv + 198, xvi + 237. ill. London 1907. (*Recd.* 9/4/7.)

From the Publishers: Messrs. J. & A. Churchill.

Danneel, *Heinrich.* Electrochemistry. I. Theoretical electrochemistry and its physico-chemical foundations. Translated from the Sammlung Göschen by *Edmund S.* **Merriam.** pp. vii + 181. ill. New York 1907. (*Recd.* 12/4/7.)

From the Publishers: Messrs. John Wiley and Sons.

Meldola, *Raphael*, **Green**, *Arthur George,* and **Cain**, *John Cannell* [Editors]. Jubilee of the discovery of mauve and of the foundation of the coal tar colour industry by Sir W. H. Perkin. pp. 77. ill. London [1907]. (*Recd.* 21/3/07.) From the Executive Committee.

Whipple, *George C.* The value of pure water. pp. viii + 84. New York 1907. (*Recd.* 12/4/7.)

From the Publishers: Messrs. John Wiley and Sons.

II. *By Purchase.*

Eckel, *Edwin C.* Cements, limes, and plasters. Their materials, manufacture, and properties. pp. xxxiv + 712. ill. New York 1905. (*Recd.* 3/4/7.)

Paracelsus, *Theophrastus.* [Paracelsus his Archidoxis: comprised in ten books, disclosing the genuine way of making Quintessences, Arcanums, Magisteries, Elixirs, &c. . . . And finally his seven books, of the degrees and compositions of receipts, and natural things. Faithfully Englished, and Published by *J. H.* **Oxon**, London 1661.] pp. [vi] + 158 + [ii] + 176 [wrongly numbered 171]. Title-page missing. (*Reference.*)

III. *Pamphlets.*

Day, *Arthur L.* Mineral solution and fusion under high temperatures and pressures. (From the *Fifth Yearbook of the Carnegie Institution, Washington.*) 1907.

Gowland, *William.* Copper and its alloys in prehistoric times. (From the *J. Anthropological Inst.*, **36**, 1906.)

Lauder, *Alexander*. Variation in the composition of milk. pp. 52. Edinburgh 1906.

Richards, *Theodore William*, and **Behr**, *Gustavus Edward.* The electromotive force of iron under varying conditions, and the effect of occluded hydrogen. *Carnegie Institution of Washington, Publication* No. 61. 1906.

Richards, *Theodore William*, and **Forbes**, *George Shannon.* Energy changes involved in the dilution of zinc and cadmium amalgams. *Carnegie Institution of Washington, Publication* No. 56. 1906.

White, *Walter P.* The constancy of thermo-elements. (From the *Physical Review*, **23**, 1906.)

At the next Ordinary Meeting on **Thursday**, May **2nd**, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :

"The chemical action of exradio. Part I. Action on distilled water." By Sir W. Ramsay.

"Freezing-point curves of the menthyl mandelates." By A. Findlay and E. M. Hickmans.

"The constitution of homo-eriodictyol. A crystalline substance from eriodictyon leaves." By F. B. Power and F. Tutin.

"The relation between valency and heats of combustion. Preliminary note." By G. Le Bas.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 2nd, 1907.

Allan, John Campbell,

91, Norse Road, Scotstoun, Glasgow.

Analytical Chemist. For 10 years assistant in the private Laboratory of Messrs. R. R. Tatlock & Thomson, Analytical and Consulting Chemists, Glasgow, and for 2 years was chief assistant. During the last 2 years was Chemist to the Cawnpore Sugar Works, Ltd., Cawnpore.

R. R. Tatlock.
Harry Dunlop.
R. T. Thomson.
John Clark.
James McLeod.

Bailey, Francis James,

Findon Hill, Sacriston, Durham.

Teacher. Inter. B.Sc. London University. At present Lecturer under the Durham County Council in Theoretical and Practical Inorganic Chemistry, and Student in the Sunderland Technical College with a view to taking Chemistry (Honours) in B.Sc. Exam. (London). Formerly Student at Barrow, and Royal College of Science, and Teacher of Chemistry in Organised School of Science, Bruce Grove, N.

W. Meredith.
A. Crabtree.
A. Houldershaw.
A. R. Gower.
Richd. Spencer.

Ball, William Robert,

48, Cambridge Road, Thornaby-on-Tees.

Science Teacher. A Chemistry Teacher at Secondary School, Stockton-on-Tees (1896—1907). B.Sc. (London) in Chemistry, &c.

J. G. Taylor.
J. Seabury Smythe.
J. Handby Ball.
H. M. Atkinson.
Walter Thorp.

Caldwell, Kenneth Somerville,

Demonstrator in Chemistry, St. Bartholomew's Hospital, E.C.

1851 Exhibitioner; Graduate of the Univ. of Wales (B.Sc., 1st Class Hons.), and of Leipzig (Ph.D., Summa cum Laude).

Kennedy J. P. Orton. James J. Dobbie.
W. H. Hurtley. Alexander Lauder.
H. W. M. Willett.

Cameron, Alexander Thomas,
Burtonhill, Malmesbury, Wilts.

Research Student in Chemistry. M.A., B.Sc. (Edin.), 1851 Exhibition Scholar (Edin., 1906), Assistant to the Lecturer in Chemistry, Surgeons' Hall, and Dick Veterinary College, Edinburgh, 1904—6. Author of: (i) "Variations in the Crystallisation of Potassium Hydrogen Succinate," *Proc. R.S.E.*, 25, 401—403; (ii) "Constitution of Complex Salts. I. Derivatives of the Sesquioxides," *Proc. R.S.E.*, 25, 722—737.

Hugh Marshall. Alex. Crum Brown.
Leonard Dobbin. William Ramsay.
Samuel Smiles.

Cunningham, John Arthur, B.A., R.U.I. & Cantab., A.R.C.Sc.I., Formerly 1851 Exhibition Research Scholar, Cambridge,
The Observatory, Alipore, Calcutta.

Professor of Chemistry, Presidency College, Calcutta. Author of "A Contribution to the Theory of the Order of Crystallisation of Minerals in Igneous Rocks," *Proc. Roy. Dublin Soc.*, IX., p. 383, 1901; "On an Attempt to Detect the Ionisation of Solutions by the Action of Light and Röntgen Rays," *Proc. Camb. Phil. Soc.*, XI., p. 431, 1902; "The Discharge of Electricity through Gases and the Temperature of the Electrodes," *Phil. Mag.*, Dec., 1902; "The Cathode Fall from Hot Carbon," *Phil. Mag.*, Feb., 1905, &c.

W. N. Hartley. W. E. Adeney.
P. C. Rây. Richard J. Moss.
James H. Pollok. S. Ruhemann.
Hugh Ramage.

Duckworth, Samuel, B.Sc.,
78, Alexandra Road, Lowestoft, Suffolk.

Lecturer in Science and Secondary School Teacher. Graduated B.Sc. (Victoria) and obtained M.Sc. in Chemistry. Lecturer in Chemistry in the Lowestoft Technical School.

Harold B. Dixon. G. H. Bailey.
D. L. Chapman. Norman Smith.
W. H. Perkin, jnr. J. F. Thorpe.

Fox, John Jacob,
6, Alkham Road, Stamford Hill, N.

Analyst in Government Laboratory. Royal College of Science, 1897–99; Government Laboratory since 1899; East London College since 1899.

T. E. Thorpe. H. W. Davis.
E. Grant Hooper. J. T. Hewitt.
C. Smith.

Gibson, Charles Stanley, B.A.,
45, Shakespeare Street, Manchester.

Engaged in research work at the Municipal School of Technology, Manchester. Second class Final Honour, School of Natural Science (Chemistry), Oxford University, 1905. Formerly, Natural Science Scholar of Corpus Christi College, Oxford.

W. J. Pope. W. W. Fisher.
John Watts. J. E. Marsh.
Henry A. Miers. D. H. Nagel.
S. J. Peachey.

Gregory, Joshua Craven,
126, Woodlands Road, Glasgow.

Analytical and Consulting Chemist and Metallurgist. B.Sc. (Lond.), F.I.C. Author of "A Short Introduction to the Theory of Electrolytic Dissociation" (Longmans, 1905), and "First Steps in Quantitative Analysis" (Edward Arnold, 1905). Joint author with F. W. Richardson, Esq., F.I.C., &c., of "Tartaric Acids and Tartrates, their Polarimetric Estimation," *J.S.C.I.* Analytical experience in the laboratories of F. W. Richardson, Esq. (Bradford City Analyst), and of T. V. Hughes, Esq., Birmingham; also at Kidderminster School of Science. At present partner in Robertson and Gregory, 128, Wellington Street, Glasgow, analysts. Also had experience in teaching chemistry at Kidderminster School of Science, &c.

F. W. Richardson. A. Jaffé.
Frederick D. S. Robertson. T. Vaughan Hughes.
J. B. Cohen.

Hall, Joseph Henry,
84, The Grove, Wandsworth, S.W.

Schoolmaster. Student in Chemical Laboratories for 8 years. Bachelor of Science, London University. Board of Education Certificates in Theor. Chemistry, Stages 2 and 3 Inorg., Stage 2

Organic; Prac. Chem., Stage 2, and Part I. Hons. Inorg., Stage 3 Organic.

Alfred Greeves. Frank E. Weston.
H. R. Ellis. W. G. Sewell.
H. Stanley Redgrove.

Harrington, Arthur George,

"Rochford," Westbury Road, Ealing, W.

Chemist. Major examination of the Pharmaceutical Society. Intermediate Examination of the Institute of Chemistry, and at present working under Mr. E. W. Lucas, F.I.C., F.C.S.

William Ramsay. Edward C. Cyril Baly.
Samuel Smiles. R. W. Gray.
N. T. M. Wilsmore. E. W. Lucas.
Arthur W. Crossley.

Harvey, Thomas Featherstone,

84, Henry Road, West Bridgford, Nottingham.

Analytical Chemist. Pharmaceutical Chemist (by examinations). Author of the following and other papers: "The Wijs Method of Determining the Iodine Value of Oils and Fats" (*Journ. Soc. Chem. Ind.*, 1902, 1437); "Determination of the Iodine Absorption of Oil of Turpentine" (*J.S.C.I.*, 1904, 413); "Detection and Estimation of Arsenic by the Gutzeit Test" (*Chemist and Druggist*, 1905, I. 168); "Temperature Corrections for Use with the Abbe Refractometer, &c." *J.S.C.I.*, 1905, 717); "The Composition of Nux Vomica Fat" (Harvey and Wilkie, *J.S.C.I.*, 1905, 718). Analyst and Works Chemist to manufacturing firms for the past 12 years.

R. M. Caven. Harold B. Holthouse.
Charles Spackman. *F. Stanley Kipping.*
L. Archbutt. *Peter MacEwan.*

Hope, Geoffrey Dodleston,

Heath Heys, Oxton, Birkenhead.

Student, working at present under Prof. Donnan at Liverpool University. B.Sc. (Victoria and Liverpool); Ph.D. (Halle, Germany).

J. Campbell Brown. F. G. Donnan.
A. W. Titherley. *W. Collingwood Williams.*
Prosper H. Marsden.

Houghton, Edward,

Glenhyrst, 106, Saltergate, Chesterfield.

Analytical Chemist (Iron Works). Matriculated at London, 1898. Lancashire County Council Science Scholar, 1900; 3 years' Metallurgical Training at Manchester School of Technology; 4 years' experience as Assistant Works Chemist to the Darwen and Mostyn Iron Co., Darwen; 2 years' experience as Head Chemist to the Sheepbridge Coal and Iron Co., Chesterfield. Author of paper on the "Chemistry of Cast Iron," British Foundrymen Assoc., 1906. Reason for desiring admission, to keep in touch with pure science and other branches of applied science than my own.

Joseph West.	Robert H. Pickard.
James Smith.	*John Hanley.*

Samuel Banner.

Hubbard, The Hon. Raymond Egerton,

Addington Manor, Winslow, Bucks.

Undergraduate of Magdalen College, Oxford.

Harold Hartley.	D. H. Nagel.
T. S. Moore.	A. F. Walden.

N. V. Sidgwick.

Humphries, Herbert Brooke Perren,

117, Avenell Road, Highbury, N.

Science Master, Enfield Grammar School. B.Sc. (Hons. Chem.); A.R.C.Sc. (Chem.). Science Master, Enfield Grammar School. Engaged in research under the guidance of Dr. McKenzie at the Birkbeck College.

William A. Tilden.	J. C. Philip.
M. O. Forster.	Alex. McKenzie.
G. T. Morgan.	Henry Wren.

Lewis, Carl,

P.O. Box 36, Johannesburg.

Chemist. Chemist and Druggist. Member of the Pharmaceutical Society of Great Britain. Practised Pharmacy for four years in Johannesburg. Studied for one year at the London College of Pharmacy, where I was medallist in Pharmacy.

George Gordon Watt.	Thomas Tyrer.
Frederick W. Evans.	*David J. Williams.*

Herbert A. Mills.

McConnan, James,

Danehurst, Greenbank Drive, Liverpool.

Assistant Lecturer and Demonstrator in Organic Chemistry, University of Liverpool. Degrees: M.Sc., Victoria and Liverpool; Ph.D., Jena. Publications: "Beiträge zur Kenntniss der Pyrazole" (Dissertation, Jena, 1904); "Labile isomerism among Acyl Derivatives of Salicylamide" (in conjunction with Dr. A. W. Titherley), *Trans.*, 1906, 89, 1318.

J. Campbell Brown. Prosper H. Marsden.
A. W. Titherley. F. G. Donnan.
W. Collingwood Williams.

Mitchell, Herbert Victor,

26, Brookfield Avenue, Walthamstow.

Analytical and Research Chemist. One time analyst and research chemist to Messrs. Burgoyne, Burbidges & Co.; two and a half years in Sir Boverton Redwood's Laboratory, and subsequently Assistant Demonstrator at East London College. Author, or part-author, of several papers published by the Society.

J. T. Hewitt. Boverton Redwood.
C. Smith. A. E. Dunstan.
T. W. Firth Clark.

Rhodes, Percy Joseph,

Bridge House, Church, Lancashire.

Technical Chemist, Bleacher, Dyer, and Calico Printer. Studied at the Macclesfield School of Science, Mechanics Institute, Stockport, and the Stockport Technical School. At present Technical and Works Manager for Messrs. F. Steiner & Co., Ltd., Turkey Red Dyers, Bleachers, and Calico Printers, Church Works.

Alfred J. King. William Marshall.
W. H. Pennington. L. G. Radcliffe.
Christr. Rawson. *J. C. Cain.*
A. G. Green.

Rixon, Frederic William, M.Sc., Ph.D.,

Powderham Road, Newton Abbot, Devonshire.

County Science Instructor. Assistant Professor of Chemistry, Merchant Venturers' College, Bristol. B.Sc. with 1st Class Honours in Chemistry, Victoria University. Fellow of the University. Ph.D., Giessen. Joint author of following papers: "On the Specific Heats of Carbon Dioxide at High Temperatures" (Brit. Assoc.) with Prof. H. B. Dixon; "Ueber die Kathodische Ausscheidung von Blei" (*Zeitsch. Elektrochem.*) with Prof. Elbs.

Harold B. Dixon. G. H. Bailey.
W. H. Perkin, jnr. Norman Smith.
J. F. Thorpe.

Robinson, John,

Agricultural College, Aspatria, Cumberland.

Analyst, and Lecturer in Chemistry (Agric. and Pure). National

Diploma in Agric., and National Diploma in Dairying. Advanced Certificates (Science and Art) in Pure and Agric. Chemistry. Three years a Student at the Agric. College, Preston. Now Lecturer (and Analyst) in Agric. and Pure Chemistry at Agric. College, Aspatria, Cumberland.

R. R. Swann.
T. W. Fagan.
R. Henry Jones.
S. Hoare Collins.
John Alexander.

Smith, Sydney William,
76, Norroy Road, Putney, S.W.

Assistant Assayer at the Royal Mint. Bachelor of Science (London). Associate of the Royal School of Mines. 1899—1902, Assistant to the late Sir William Roberts-Austen. 1902—1907, Assistant Assayer at the Royal Mint.

T. K. Rose.
W. Gowland.
W. H. Merrett.
E. O. Courtman.
John Phelps.
J. Brierley.
F. W. Harbord.
G. T. Morgan.

Sturrock, George Colleymore,
Aruvankad, Nilgiris, India.

Captain, Royal Artillery. Assistant Superintendent, Indian Cordite Factory. Studied at Royal Military Academy, Woolwich (2 years), and at Ordnance College, Woolwich (1 year) under Professor Hodgkinson.

W. R. Hodgkinson.
Robert Robertson.
William Rintoul.
Arthur H. Coote.
J. S. S. Brame.

Sutcliffe, Sam Mortimer,
4, Clive Place, Bradford.

Analytical Chemist. Partner in the firm of Sutcliffe and Murgatroyd, Analytical and Consulting Chemists. Assistant to C. Rawson, Esq., F.I.C (Analytical Consulting Chemist), for two and a half years. Chief assistant for four and a half years to Messrs. Rawson and Petraczek. Formerly student in the Chemistry and Dyeing Department at the Bradford Technical College.

C. Rawson.
Ad. Liebmann.
Thorp Whitaker.
Joshua Knowles.
William E. Kay.
W. H. Pennington.
William. G. White.

Tarr, Nicholas,

Lucton School, Herefordshire.

Lecturer in Science and Mathematics. One year student at University Tutorial College, London; 4 years student at St. George's Hospital, London; 4 years and 3 months Senior Master in Science and Maths. Passed Intermediate Exam. in Chemistry, Physics, and Zoology.

J. Addyman Gardner.
Frank B. Last.
Chas. Slater.
F. G. Martin.
Edmund Lamb.

Tebb, William Scott,

Sandfield, Putney Heath Lane, S.W.

Public Analyst for Southwark. M.A., M.D. (Cantab.), D.P.H., F.I.C.

Alexander Scott.
W. D. Halliburton.
James Dewar.
O. Rosenheim.
John M. Thomson.

Tonner, William Griffiths,

26, Gordon Road, Kingston-on-Thames.

Schoolmaster. B.Sc. (Univ. of Wales); Research Student at Birkbeck College, London; and Science Master at Tiffins' School, Kingston.

Alex. McKenzie.
Claude M. Thompson.
Henry Wren.
E. P. Perman.
Maurice Blood.

The following Certificate has been authorised for presentation to Ballot by the Council under Bye-law I (3):

Dealy, Thomas Kirkman,

Craigmin East, Magazine Gap, Hongkong.

Second Master, Queen's College, Hongkong (Hongkong Civil Service). As a Student in Training, passed the South Kensington Advanced Course of Inorganic Chemistry, and went through a year's laboratory practice in Inorganic Chemical Analysis (Qualitative), metals and non-metals. Take a lively interest in Chemical Science, both as student and practical teacher.

T. Luxton.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 11/5/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 325.

Thursday, May 2nd, 1907, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Mr. A. V. Hussey was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Owen Aubrey Elias, 123, Waller Road, New Cross, S.E.
Walter Harold Nuttall, 55, Market Street, Watford, Herts.
Walter Ormston Young, Springfield, Cartmel, Lancs.
Israel Hyman Zortman, B.Sc., Sternwartenstr. 44 II r, Leipzig.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

John Campbell Allan.
Francis James Bailey.
William Robert Ball, B.Sc.
Kenneth Somerville Caldwell, B.Sc., Ph.D.
Alexander Thomas Cameron, M.A., B.Sc.
John Arthur Cunningham, B.A.
Thomas Kirkman Dealy.
Samuel Duckworth, B.Sc.
John Jacob Fox.
Charles Stanley Gibson, B.A.
Joshua Craven Gregory, B.Sc.
Joseph Henry Hall, B.Sc.
Arthur George Harrington.
Thomas Featherstone Harvey.
Geoffrey Doddleston Hope, B.Sc., Ph.D.
Edward Houghton.
Hon. Raymond Egerton Hubbard.
Herbert Brooke Perren Humphries, B.Sc.
Carl Lewis.
James McConnan, M.Sc., Ph.D.
Herbert Victor Mitchell.
Percy Joseph Rhodes.
Frederic William Rixon, M.Sc., Ph.D.
John Robinson.
Sydney William Smith, B.Sc.
George Colleymore Sturrock, Capt. R.A.
Sam Mortimer Sutcliffe.
Nicholas Tarr.
William Scott Tebb, M.A., M.D.
William Griffiths Tonner, B.Sc.

Of the following papers, those marked * were read :

*90. "The chemical action of the radium emanation. Part I. Action on distilled water." By Sir William Ramsay, K.C.B.

A qualitative confirmation of the fact noticed by Rutherford that the emanation from radium, in decaying, evolves a large amount of heat has been obtained ; the relative amounts of hydrogen and oxygen produced by the action of radium bromide on water, amounting to 32 c.c. of explosive gases per gram of radium per one hundred hours, have been measured, and also the excess of hydrogen, of which the mean value is 5·5 per cent., reckoned on the total gas. Reasons were adduced to show that hydrogen is not one of the products of degradation of radium, and other hypotheses to account for the excess of hydrogen were considered.

The action of the emanation alone on water also decomposes it into explosive gas, mixed with excess of hydrogen ; it has been shown that the emanation, when mixed with explosive gas, causes recombination, and the rate at which the decomposition of water takes place has been measured.

The reason of the production of excess of hydrogen has not yet been elucidated.

DISCUSSION.

Professor TILDEN said that although the subject which had been brought before them by the President would probably not admit of much discussion, they would be ready to unite in expressing their admiration of the remarkable skill which had been displayed in the manipulation and measurement of such strange material in quantities so minute. They must also commend the self-restraint which Sir William Ramsay had imposed on himself in refraining from speculation in a field which offered so much temptation and where there was room for so much difference of opinion.

The PRESIDENT, in answer to a question, replied that the emanation was an inactive gas, in the sense of not forming compounds, but at the same time, a most active gas, inasmuch as it decomposes or disintegrates into a series of other bodies, some of which, at least, are capable of chemical combination.

*91. "Freezing point curves of the menthyl mandelates." By Alexander Findlay and Evelyn Marion Hickmans.

From a study of the freezing point curve for mixtures of *l*-menthyl *l*-mandelate and *l*-menthyl *d*-mandelate, it is found that *l*-menthyl *r*-mandelate exists as a definite, partially racemic compound having a stable melting point of 83·7°. By applying the law of mass action and the law of the depression of the freezing point by dissolved substances, the degree of dissociation of the partially racemic compound has been calculated to be about 50 per cent. It was also pointed out that other freezing point curves indicate the existence of true racemates in the liquid state.

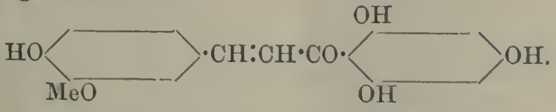
DISCUSSION.

The PRESIDENT asked whether it had been proved that racemic compounds possessed double the molecular weight of the *d*- or *l*-compounds, and whether they might therefore be regarded as composed of one molecule of each variety.

Dr. FINDLAY, replying to Dr. Lowry, stated that calculations had not been made with regard to the stability of hydrated salts, but that the method of calculation referred to would be applicable also in such cases. In reply to the President, Dr. FINDLAY stated that the arguments adduced for the existence of a racemic compound held only for the fused state, not for solutions, although it is highly probable that undissociated racemic compounds exist to some extent even in solution.

*92. "The constitution of homo-eriodictyol. A crystalline substance from eriodictyon leaves." By Frederick Belding Power and Frank Tutin.

The substance designated *homo-eriodictyol*, $C_{16}H_{14}O_6$ (m. p. 223°), previously isolated and described by the authors (*Pharm. J.*, 1906, **77**, 381, and *Abstr.*, 1906, **90**, ii, 885), has now been further investigated. It is isomeric with hesperitin (*Ber.*, 1881, **14**, 970), and similar to the latter in many of its properties, but its sodium compound has the normal formula $C_{16}H_{13}O_6Na$ (compare Perkin, *Trans.*, 1898, **73**, 1037). Homo-eriodictyol contains one methoxyl group and yields a *tetra-acetyl* derivative, $C_{16}H_{10}O_6(COMe)_4$ (m. p. 154°). On fusion with potash it gives protocatechuic acid. When homo-eriodictyol is hydrolysed with a concentrated aqueous solution of potassium hydroxide it yields phloroglucinol and ferulic acid (4-hydroxy-3-methoxycinnamic acid). From these results it is concluded that homo-eriodictyol must possess the following constitution:



The "eriodyctionon," recently described by Mossler (*Annalen*, 1907, **351**, 233), is evidently identical with homo-eriodictyol.

Eriodictyol, $C_{15}H_{12}O_6$ (m. p. 267°), a crystalline substance which was also isolated by the authors from eriodictyon leaves (*loc. cit.*), contains no methoxyl group. When heated with acetic anhydride it yielded two compounds, melting at 137° and 195—196° respectively. It is considered probable that homo-eriodictyol is a mono-methyl ether of eriodictyol.

93. "The relation between valency and heats of combustion. Preliminary note." By Gervaise Le Bas.

It is now known that valency is a volume property of the atoms (Barlow and Pope, *Trans.*, 1906, 89, 1675; Le Bas, *Trans.*, 1907, 91, 312), and the author has found that valency may also be regarded as an energy property; this conclusion can be illustrated with the aid of the heats of combustion of the hydrocarbons.

The heat of combustion of a substance may be regarded as made up of (*a*) an absorption of heat due to the dissociation or decomposition and (*b*) an evolution of heat due to the combination of the isolated atoms with oxygen. A study of molecular heats of combustion, however, reveals the following law, which appears to be generally valid. *The heat of combustion of an organic compound is equal to the sum of the heats of combustion of its possible dissociation products.*

The conclusion is therefore drawn that the factor *a* is negligibly small as compared with *b*. In illustration of this may be cited the facts that the heats of combustion of a normal paraffin and its carboxyl derivatives are identical provided that the physical state be taken into account, and that the heats of combustion of associated substances or of polymerides are the same as those of an equivalent number of simple molecules. It may be shown that the thermal constants of the alcohols, ethers, organic halogen compounds, carboxylic acids, esters, nitriles, amines, mercaptans, and other classes of compounds also follow this law.

The heats of combustion of organic compounds in most cases are found to be the same as those of saturated and unsaturated hydrocarbons and hydrogen, or of mixtures of these. Similarly, the factor *a* is negligibly small as compared with *b* in the case of the saturated and unsaturated hydrocarbons, and therefore their heats of combustion are sensibly those of their isolated atoms, *plus* an excess for the latter, owing to unsaturation. The additive relations obtained lead to a second law which applies to all the hydrocarbons.

The molecular heats of combustion of the hydrocarbons are proportional to their valency numbers W. For example, the heat of combustion of a normal paraffin, C_nH_{2n+2}, in the gaseous state is given by the expression

$$M.H.C. = (6n+2)c = W.c.,$$

c being a constant, representing the heat equivalent of one hydrogen atom expressed in large calories.

This law is illustrated by the following table, in which Thomsen's values are used:

		$W.$	$c.$	$W.c.$	Calc. $M.H.C.$
Methane	CH_4	8	26·49	211·7	211·9
Ethane	C_2H_6	14	26·45	370·4	370·4
Propane............	C_3H_8	20	26·46	529·2	529·2
Butane	C_4H_{10}	26	26·43	687·9	687·2
Pentane............	C_5H_{10}	32	26·46	846·7	847·0
Mean			26·46		

The heat value of the difference for the homologous increment CH_2 is calculated to be equal to $6c = 6 \times 26{\cdot}46 = 158{\cdot}76$, which is similar to that observed.

The conclusion is also drawn that the molecular heats of combustion of compounds do not lend themselves to the determination of constitution. From certain peculiarities which are connected with olefine and acetylene linkings, it is, however, possible to recognise the presence of the latter in a compound with certainty.

94. "The velocity of hydrolysis of aliphatic amides by alkali."

By James Codrington Crocker and Frank Harold Lowe.

The rate of reaction of the aliphatic amides with sodium hydroxide has been investigated at from 40·06° to 95·9°.

The reactions are shown to follow the bimolecular relation

$$K = \frac{1}{at}\left[\frac{1}{c} - \frac{1}{c^\circ}\right],$$

where a is the degree of dissociation of the alkali. The graphs between the reciprocal of concentration and time are very approximately straight lines with a slight curvature indicating a small retarding effect of the neutral salt. If the amides are arranged in decreasing order of reactivity, this order is: formamide, acetamide, propionamide, capronamide, butyramide, *iso*butyramide, valeramide, the temperature variation of reactivity over the above range is best expressed by the formula $\log K = \log K^\circ + B\left(\frac{1}{T^\circ} - \frac{1}{T}\right) + C\left(\frac{1}{T^\circ} - \frac{1}{T}\right)^2$.

The mean differential coefficient of the graph between $\log K$ and $\frac{1}{T}$ for the above range is less than for the analogous case of hydrolysis by acid. The view is taken that hydrolysis by alkali of the amides proceeds by the direct action of the hydroxyl ion on the amide molecule. A modification of the Arrhenius hypothesis was suggested to explain the exponential variation of reactivity with temperature, a parallel being drawn between tautomeric change, where difference of property is produced by the "wandering" of an atom, and "electromeric" change, where difference of property is caused by the movement of an electron.

95. "The addition of iodine to acetylenic acids." By Thomas Campbell James and John Joseph Sudborough.

Good yields of the di-iodides of tetrolic and phenylpropiolic acids are formed when a concentrated aqueous solution of cupric sulphate (1 mol.) is gradually run into a well-stirred aqueous solution of the potassium salt of the acid (1 mol.) mixed with an excess of potassium iodide. The di-iodides may be isolated by warming the solution, removing the cuprous iodide, and acidifying with a mineral acid.

The same di-iodides may be prepared by mixing aqueous solutions of the potassium salts with an excess of a potassium solution of iodine in iodide and allowing to stand for several days.

Definite di-iodides could not be isolated from *o*- and *p*-nitrophenylpropiolic acids, or from acetylenedicarboxylic acid, although in the two former cases an addition of iodine occurs.

Olefinic acids, even when they contain conjugated bonds, do not combine with iodine to any appreciable extent.

The velocity constants for the reactions between a solution of iodine in potassium iodide and the potassium salts of tetrolic, phenylpropiolic, *o*- and *p*-nitrophenylpropiolic acids have been determined. The reaction in each case is bimolecular when aqueous solutions are employed.

The reaction between iodine and phenylpropiolic acid has been studied in absolute alcoholic and in aqueous alcoholic solutions, both with and without the addition of potassium iodide.

96. "The chemical changes induced in gases submitted to the action of ultra-violet light." By David Leonard Chapman, Samuel Chadwick, and John Edwin Ramsbottom.

An apparatus specially designed for the examination of the chemical changes brought about in gases by the influence of the light emitted from a mercury lamp was described. With the aid of the apparatus the conversion of oxygen into ozone, the interaction of carbon monoxide and oxygen, and the decomposition of carbon dioxide have been investigated particularly with a view to ascertaining the effect, in each case, of the presence of varying amounts of water vapour.

Dry carbon dioxide is decomposed by ultra-violet light, the percentage decomposition being increased by a reduction of pressure, but, under the same conditions, the moist gas at all pressures remains practically unchanged. The rate of contraction of a mixture of carbon monoxide and oxygen is practically independent of the degree of desiccation of the gases, and this was found to be due to the fact that, although the presence of moisture causes the rate of formation of carbon dioxide to rise, it results in a equivalent reduction in the yield of ozone.

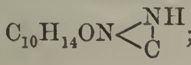
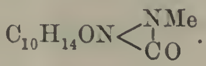
97. "Studies of the perhalogen salts. Part. I."
By Charles Kenneth Tinkler.

The well-known formation of periodides by the addition of iodine to a solution of an iodide has been investigated by means of the ultra-violet absorption spectra of the solutions. Whilst neither a *N*/100 aqueous solution of iodine nor dilute solutions of iodides show any characteristic absorption in the ultra-violet, the aqueous solutions of iodine, after the addition of various iodides, all give the same spectra, which show a large amount of general absorption and two absorption bands.

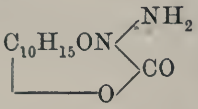
Solutions of iodine to which various soluble bromides or chlorides have been added also give evidence, from their spectra, of the presence of addition compounds of the halogen salt and iodine.

It can be shown from the spectra of the solutions, that with equimolecular quantities of potassium iodide, bromide or chloride combination takes place most readily with the iodide and least with the chloride. On the addition of hydriodic, hydrobromic, or hydrochloric acids to the aqueous solution of iodine, the spectra of the solutions are the same as those containing the corresponding metallic salts; hydriodic acid, however, appears to combine with iodine when the acids are passed into a chloroform solution of this substance.

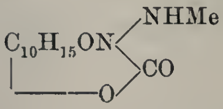
98. "The interaction of cyanodihydrocarvone, amyl nitrite, and sodium ethoxide." By Arthur Lapworth and Elkan Wechsler.

Cyanodihydrocarvone, when subjected to the action of amyl nitrite and sodium ethoxide, is converted into a compound, isomeric with the expected *iso*nitroso-derivative, but which investigation has shown to be a *lactam*,  $C_{10}H_{14}ON{<}\begin{array}{l}NH\\ |\\ C\end{array}$; this is feebly acidic and may be converted into a neutral *methyl* derivative,  $C_{10}H_{14}ON{<}\begin{array}{l}NMe\\ |\\ CO\end{array}$. On treatment with dilute alkali these yield the corresponding *amino-acids*, from which they may again be obtained by means of dihydrating agents.

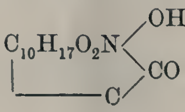
The lactams are converted by cold acids into *lactonic bases*,



and



which, on hydrolysis with hot dilute acids, yield ammonia and methyl amine respectively, together with a *lactonic acid*,



,

which, although it may be titrated in the cold as a monobasic acid, is probably not carboxylic in character; with warm alkalis the lactone ring is severed and the compound behaves as a dibasic acid.

All these compounds, by prolonged treatment with hot mineral acid, are converted into a pseudo*cumene carboxylic acid* ($CO_2H : Me_3$ = probably 1 : 2 : 3 : 5). This is dimorphous, the forms melting at 84° and 105—106 respectively.

99. "Contributions on the chemistry of oxygen compounds. II. The compounds of cineol, diphenyloxide, nitroso-derivatives, and the carbamides with acids and salts." By Robert Howson Pickard and Joseph Kenyon.

The authors have investigated the capacity of various compounds containing oxygen to form additive compounds analogous to those of the phosphine oxides (Part I., *Proc.*, 1906, 22, 42) with the view of throwing some light on the influence (if any) of the phosphorus atom. No regularity can be observed in the molecular proportion of substances containing oxygen in their additive compounds.

It is suggested that the formation of additive compounds by sulphoxides and nitroso-compounds and the non-formation of the same, in general, by sulphones, nitro- and azoxy-compounds is probably due to the position of the oxygen atoms of the latter in a ring, so that any subsidiary or residual valency is internally satisfied. As the aryl substituted carbamides form salts and as, in general, the carbamides behave in regard to the formation of additive compounds in a similar manner to the phosphine oxides, cineol &c., it is probable that the additive compounds formed by the carbamides are due to the subsidiary valency of the oxygen atom, which in these compounds, as in the phosphine oxides, is influenced by the proximity of the nitrogen or phosphorus atom respectively. The additive compounds of cineol with magnesium alkyl halides are decomposed when heated, and the product when treated with dilute acids yields Δ^1-*p*-terpineol (8).

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Saturday, 8th June, 1907.

Those Fellows who received grants in June, 1906, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Saturday, 1st June, next.

On Thursday, June 13th, 1907, Professor J. B. Farmer, F.R.S., will deliver a discourse entitled "Some Borderline Problems in Botany."

ERRATUM.

1907. P. 120, line 16 from top, *for* "Toluoyl" *read* "Phenylacetyl."

At the next Ordinary Meeting, on **Thursday**, May **16th**, 1907, at **8.30** p.m., the following papers will be read :

"The relation between the crystalline form and the chemical constitution of simple inorganic substances." By W. Barlow and W. J. Pope.

"Experimental investigation into the process of dyeing." By J. Hübner.

"Some derivatives of *p*-pyranol allied to certain derivatives of brazilein and hæmatein." Preliminary communication. By W. H. Perkin, jun., and R. Robinson.

"Mixed semi-ortho oxalic compounds." By G. D. Lander.

"The mechanism of bromination of acylamino-compounds." Preliminary notice. By J. B. Cohen and W. E. Cross.

"Separation of cadmium from zinc as sulphide in the presence of trichloracetic acid." By J. J. Fox.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/5/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 326.

Thursday, May 16th, 1907, at 8.30 p.m., Prof. R. MELDOLA, F.R.S., Past President, in the Chair.

Mr. E. Gardner was formally admitted a Fellow of the Society.

It was announced that the following address would be presented to the Société Chimique de France on the occasion of the celebration of its Jubilee.

ADDRESS FROM THE CHEMICAL SOCIETY TO THE SOCIÉTÉ CHIMIQUE DE FRANCE.

The ties of sympathy connecting the Chemical Society of France and the Chemical Society resemble the bonds uniting members of the same family rather than those associating friends drawn together by mere community of interests.

On the occasion of our Jubilee celebration in 1891 your representative, M. Gautier, then President of the Société Chimique de Paris, reminded us that, prior to your foundation in 1857, M. Wurtz had paid a special visit to London in order to study the organisation of our Society, which had then been in existence for sixteen years, and further remarked "La Société Chimique de Londres a été le modèle et la grande sœur de la Société Chimique de Paris."

It is now the privilege of the elder sister to send through her appointed delegates the congratulations of all English chemists to the Société Chimique de France on completing fifty years of active work in widening the boundaries of a science which has conferred such inestimable benefits on humanity.

How magnificent have been the contributions to knowledge made by your Society during those five decades is witnessed by your Bulletin, which in itself represents a historical survey of modern chemistry.

The satisfaction with which our Society embraces this opportunity of taking part in your réunion is not untinged by sadness, for we can no longer hope to meet amongst you two of the most illustrious of our confrères, whose loss your country, and indeed the whole world, have so recently had to deplore. This loss is felt all the more deeply by us since one of them was the doyen of our Honorary and Foreign Fellows.

In the genius of Marcellin Berthelot, the gifted founder of chemical synthesis and of thermochemistry, were united the savant and the statesman, a combination of qualities which must be rare in any age; whilst in Henri Moissan we mourn a colleague, the products of whose industry have been well described as taking a place amongst the greatest achievements in inorganic chemistry.

(Signed) WILLIAM RAMSAY, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, ARTHUR W. CROSSLEY, } *Honorary Secretaries.*
HORACE T. BROWN, *Foreign Secretary.*

Certificates were read for the first time in favour of Messrs.:

William Arthur Colebourn, 34, Camp St., Broughton, Manchester.
Robert Cornthwaite, Agricultural Laboratory, Halifax.
Charles William Lamb Jensen, Oakhill, Nr. Bath.
Charles Horne Warner, 24, Gordon Street, Gordon Square, W.C.

A certificate has been authorised by the Council under Bye-Law I (par. 3) in favour of Ruchi Ram Sahni, M.A., Government College, Lahore, India.

Of the following papers, those marked * were read:

***100. "The relation between the crystalline form and the chemical constitution of simple inorganic substances." By William Barlow and William Jackson Pope.**

The authors pointed out that only two simple homogeneous close-packed assemblages of equal spheres exist; one of these possesses holohedral cubic symmetry, and the other holohedral hexagonal symmetry with the axial ratio, $a:c = 1:0{\cdot}8165$. They showed that close-packed homogeneous assemblages made up of two or more kinds of spheres of nearly the same size must approximate in marshalling to one or other of the above types of assemblage or some homogeneous combination of these. All the known crystalline forms exhibited by the elements can be interpreted in the light of the above geometrical principles; the latter also explain how binary compounds composed of two elements of the same valency, such as the alkali halogen compounds, crystallise in the cubic system and how silver iodide, which crystallises in the hexagonal system, exhibits the axial ratio, $a:c = 1:0{\cdot}8196$.

An examination of the isomorphous series of tri-halogen compounds, to which the compounds CsI_3 and RbI_3 belong, shows that the axial ratios of these orthorhombic substances are also in accordance with the geometrical principles stated above.

Descriptions were given of the homogeneous assemblages corresponding to the above substances and to the ammonium salts isomorphously related to certain of them. The crystalline forms of certain of the chlorates, carbonates, and nitrates were also discussed.

DISCUSSION.

Dr. DIVERS pointed out that, for the purposes of the authors, it was surely unnecessary and, as introducing complexity, undesirable to do more than equalise the axial ratios of similar crystals by applying the law of the rationality of the axes. When the authors went on to multiply the equalised ratios by the factor, $\sqrt[3]{W/ac}$, and entitled the results, "equivalence parameters," they served no useful end, since no further "equivalence" could be conferred upon ratios (or anything else, except their more complex expression) by multiplying them by this or any other factor.

He feared that the authors were risking failure to convince many chemists of the sufficiency of the assumption of their "valency volumes" to correlate chemical with crystalline structure, by demanding for the purpose of appropriate close packing that considerable deviations from simply proportioned volumes must be allowed them; for example, that volumes of a given valency are not quite equal, even under similar conditions, when they are of different chemical elements; and that, under different conditions, these volumes may vary considerably, even when of the same element; and that, also, for close packing along with preservation of mechanico-chemical structure, the valencies must be, sometimes, exceptionally chosen; that, for example the alkali metals are to be univalent in their trihalides; sulphur bivalent in sulphates; nitrogen, tervalent in nitrates, and oxygen in hydroxyl compounds, sometimes of no valency.

What seemed to him to be, also, a serious objection to the packing of atoms to represent chemical constitution was that juxtaposition of atoms expressed chemical union in some cases and not in others. He also doubted whether with close packing and pressing out all interspaces the appropriate distances between the centres of the spheres, shown undeformed in the models and diagrams, would be sufficiently preserved. But, without the experience of the authors, that was too difficult a point for others to deal with adequately.

Dr. TUTTON said he was glad that Prof. Pope in his exposition of the authors' paper had removed the doubt which had been created by their first paper as to the light in which they regarded the use of topic axial ratios. It was now made clear that their equivalence parameters were intended to supplement, for unrelated or only morphotropically related substances, the teaching of topic axial ratios with respect to the strictly related members of isomorphous series, and that the value of topic axial ratios for expressing the structual relationships of the members of such series was undoubted by them. He pointed out that these ratios depended solely on constants determinable with the highest experimental accuracy, namely, the crystallographic axial ratios, the molecular weight, and the specific gravity, and that whilst the molecular volume represented the total relative change of volume on passing from one member to another, the topic axial ratios gave the actual changes in the separation of the structural units, the chemical molecules, in the three directions of space. The equivalence parameters of the authors suffered from an apparent want of such precision, essentially so from the different nature of the problem, and Dr. Divers had seized on this apparent weak point. He (Dr. Tutton) felt sure, however, having now had time to consider the previous paper of the authors and having seen the present one by their courtesy, that they would be able fully to justify their position, and that they were on the right track. He believed that the topic axial ratios and the equivalence parameters would together afford a complete account of the relationship between crystalline structure and chemical constitution, and it was pleasant to think that the papers introducing both had been communicated to this Society.

*101. "Experimental investigation into the process of dyeing." By Julius Hübner.

The author has examined quantitatively the absorption of basic, acid, and direct dyeing colouring matters by cotton, wool, silk, and other fibrous materials at different temperatures, with and without the addition of other substances to the dye-bath.

Parallel series of measurements were made on the absorption of the several classes of colouring matters by charcoal, graphite, China clay, and lampblack, and the following conclusions were established from the comparison.

Fibres of animal origin behave towards colouring matters in the main like charcoal, whilst cotton behaves similarly to graphite.

Thus both cotton or graphite are practically unaffected by acid dyestuffs, either hot or cold, whilst wool or charcoal absorb the colouring matter freely.

The parallel behaviour of cotton and graphite and of wool and charcoal is also illustrated by the effect of acids, sodium sulphate, &c., added to the dye-bath in the case of both acid and direct dyeing colouring matters. Similar analogies of behaviour are observed in the absorption of basic colours by the materials mentioned.

The relative absorptions were determined at different temperatures.

DISCUSSION.

Dr. DIVERS pointed out the importance of this work as showing that dyeing was not of a chemical, but of a physical, nature. The fact that absorption by charcoal was of the same order of things as absorption of colours by fibres was of much interest.

Mr. GRANT HOOPER said that in the brief *résumé* of the paper which the author had given the conclusions had not been stated, and he asked whether the increased amount of colouring matter taken up by disintegrated cotton as compared with the unbroken fibre was not explained by the fact that the colour more easily gained access to the interior of the fibre when the latter was torn. He suggested that the imbricated structure of wool probably facilitated the access of dye substance to the interior of that fibre, and so accounted in a similar manner for the comparative readiness with which wool also took up colouring matter.

He further asked whether, in view of such apparent action and of the results obtained in the experiments with fibrous material on the one hand and charcoal and inorganic substances on the other, the conclusion was drawn that the dye was retained by a process of adsorption.

Dr. FEILMANN remarked that Suida had also published extensive accounts of experiments on the dyeing of mineral substances, &c., some two years or more ago, and that Suida's results seemed to show that a kind of double decomposition occurred, so that the process was of a more or less chemical character, whereas Mr. Hübner's experiments, on the other hand, tended rather to show that the process was mainly physical, depending on absorption.

102. "Esterification constants of substituted acrylic acids. Part II." By John Joseph Sudborough and Ebenezer Rees Thomas.

As an extension of the work already published (*Trans.*, 1905, **87**, 1840), the authors have determined the esterification constants of a number of unsaturated acids with methyl alcohol at 15°. The acids experimented with were cinnamic, phenyl*iso*crotonic, β-ethylacrylic, ethylidenepropionic, and allylacetic. The results indicate in a decisive manner the retarding effect which a double bond in the αβ-position has on the velocity of esterification. The constants for phenyl*iso*crotonic and cinnamic acid are in the ratio 74 : 1, and of the β-ethylacrylic, ethylidenepropionic, and allylacetic acids in the ratio 1 : 50 : 26·7.

103. "The addition of bromine to the α- and β-chloro- and bromo-cinnamic acids and their methyl esters." By John Joseph Sudborough and Gwilym Williams.

The products obtained by the addition of bromine to the α- and β-bromo- and chloro-cinnamic acids and their methyl esters have been examined in order to determine whether in each case the α- or β-compound and the stereoisomeric *allo*-compound yield the same dibromide.

The addition of bromine to the α-compounds does not take place readily in the dark. In daylight both α-bromo-acids yield the same *ααβ-tribromo-β-phenylpropionic acid*, m. p. 151—152°. The corresponding *methyl ester* melts at 47—48°. The two β-bromo-acids combine with bromine, both in the dark and in light, yielding the same *αββ-tribromo-β-phenylpropionic acid*, m. p. 146—147°. The corresponding *methyl ester* melts at 42—43° (decomp.). The α-chloro-acids do not combine with bromine in the dark, and in daylight each yields a mixture of two dibromides, which, so far, have not been separated.

The two β-chloro-acids combine more readily with bromine, yielding the same *β-chloro-αβ-dibromo-β-phenylpropionic acid*, m. p. 143—144° (decomp.).

104. "The addition of bromine to unsaturated compounds. Part I." By John Joseph Sudborough and John Thomas.

The work, of which a preliminary note has already appeared (*Proc.*, 1906, **22**, 318), has been continued. The rate of addition of bromine to various olefine acids has been determined at 15° in carbon tetrachloride solution. The accelerative effect of sunlight has been confirmed. Of the following acids examined, cinnamic, crotonic, phenyl*iso*crotonic, undecylenic, oleic, elaidic, erucic, brassidic, β-ethylacrylic, ethylidenepropionic, and allylacetic acids, all those containing the double linking in the $\alpha\beta$-position unite with bromine but slowly in the dark, whereas all the other acids absorb bromine with great readiness under the same conditions, the reaction being practically complete in a few minutes.

The characteristic behaviour of the $\alpha\beta$-unsaturated acids may be used as the basis of a method for determining whether a double linking is in the $\alpha\beta$-position with respect to the carboxylic group or not.

105. "Separation of cadmium from zinc as sulphide in the presence of trichloroacetic acid." By John Jacob Fox.

A convenient method of separating cadmium from zinc as sulphide is furnished by the use of trichloroacetic acid. The quantity of trichloroacetic acid required is at least 10 grams per 100 c.c. of solution, but much greater concentrations can be used without affecting the precipitation of cadmium as sulphide. Even when the amount of the cadmium is small (5 milligrams per 100 c.c.), concentrations of trichloroacetic acid as great as 30 grams of acid per 100 c.c. do not prevent the whole of the cadmium being precipitated.

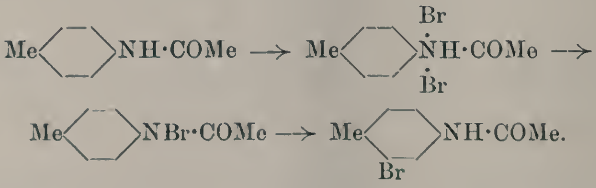
In this respect, trichloroacetic acid differs from both hydrochloric and sulphuric acids.

For the complete separation of cadmium and zinc, two precipitations are desirable; this is unnecessary, however, when the proportions of cadmium and zinc are about equal or when the cadmium is present in excess. If the presence of trichloroacetic acid is objectionable in the subsequent treatment of the solutions, a first partial separation of zinc and cadmium may be effected by the use of 1 gram of hydrogen chloride per 100 c.c. of solution.

106. "The mechanism of bromination of acylamino-compounds." Preliminary notice. By Julius Berend Cohen and William Ernest Cross.

In the ordinary process of brominating acylamino-compounds in acetic acid solution, the crystalline product which is first formed yields, on pouring it into water, the nuclear brominated compound. This intermediate compound has been isolated in the case of aceto-*p*-toluidide and crystallises in brilliant, yellow needles containing two atoms of bromine. It is very unstable in the dry state, slowly losing bromine and changing into the original compound. The same result is more rapidly effected by shaking the ethereal solution with mercury or dry potassium carbonate. The ether then contains the unchanged aceto-*p*-toluidide. If, on the other hand, the bromine compound is poured into water or shaken with pyridine, &c., hydrogen bromide is at once eliminated and a quantitative yield of 2-bromoaceto-*p*-toluidide is obtained.

The following provisional explanation is offered. An additive compound with one molecule of bromine is first formed, which in contact with water loses hydrogen bromide and gives the nitrogen bromide compound. The latter rapidly isomerises to the nuclear substituted product:



This view would conform to that of Chattaway and Orton (*Ber.*, 1899, 32, 3576), in which the formation of the nitrogen bromide compound is found to precede the isomeric change from side-chain to nucleus. Up to the present, however, the authors have failed to obtain evidence of the presence of the nitrogen bromide compound.

107. "Mixed semi-ortho-oxalic compounds."
By George Druce Lander.

The amide chlorides of methyl and ethyl oxanilates are stable below 100°. On decomposition by heat they pass by loss of hydrogen chloride into the imide chlorides, which are further resolved into alkyl chloride, carbon monoxide, and phenylcyanate, thus:

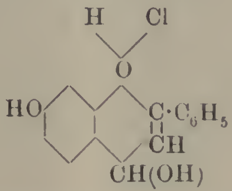
$$CO_2R\cdot CCl_2\cdot NHPh \longrightarrow CO_2R\cdot CCl{:}NPh + HCl \longrightarrow O{:}C{:}NPh + RCl + CO.$$

With sodium alkyloxides the amide chlorides yield *triethyl anilidosemi-ortho-oxalate*, $CO_2Et\cdot C(OEt)_2\cdot NHPh$, m. p. 69—70·5°, b. p. 172—174°/12 mm., and *trimethyl anilidosemi-ortho-oxalate*, similarly constituted, and having m. p. 80—82°, b. p. 182°/20 mm.

When heated under atmospheric pressure these compounds yield *ethyl* iso*diphenyloxaluric ethyl ester*, $PhN{:}C(OEt)\cdot NPh\cdot CO\cdot CO_2Et$, m. p. 101—104°, and the corresponding *methyl* iso-*ester*, m. p. 131—133° respectively. Both *iso*-esters on hydrolysis with hydrogen chloride give diphenylparabanic acid.

108. "Some derivatives of γ-pyranol allied to certain derivatives of brazilein and hæmatein." (Preliminary communication.) By William Henry Perkin, jun., and Robert Robinson.

o-Hydroxybenzaldehyde and its derivatives condense with certain acetophenone or hydrindone derivatives to form derivatives of γ-pyranol. Thus β-resorcylaldehyde and acetophenone condense readily when their solution in acetic acid is saturated with hydrogen chloride, and the 7-*hydroxy*-2-*phenyl*-1 : 4-*benzopyranol hydrochloride*,



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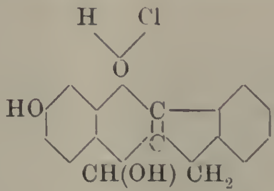
thus produced, is identical with the substance prepared by Bülow and Sicherer (*Ber.*, 1901, **34**, 3890) from benzoylacetaldehyde by condensation with resorcinol. If the acetophenone is replaced by 1-hydrindone, 7-*hydroxy*-2 : 3-*indeno*-1 : 4-*benzopyranol hydrochloride*,



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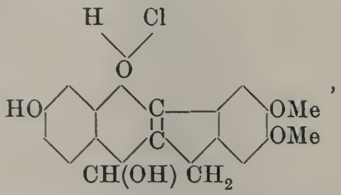
is produced. This substance crystallises with 2 molecules of water and yields, with platinum chloride, the double *salt*

$$(C_{16}H_{12}O_3,HCl)_2PtCl_4$$

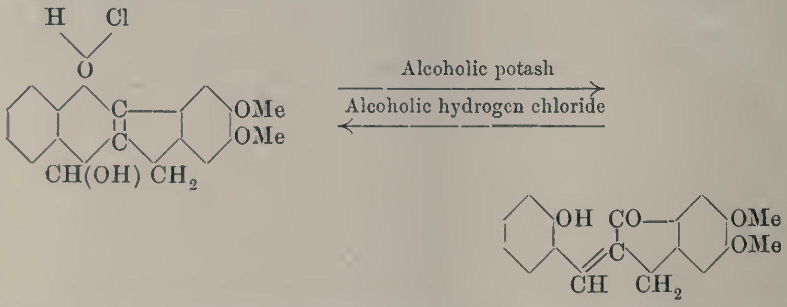
and, with gold chloride, the *salt* $C_{16}H_{12}O_3HCl,AuCl_3,H_2O$.

7-Hydroxy-5 : 6-dimethoxy-2 : 3-indeno-1 : 4-benzopyranol hydrochloride,



is obtained when β-resorcylaldehyde and 5 : 6-dimethoxy-1-hydrindone are condensed by hydrogen chloride in methyl-alcoholic solution. Similar condensations have also been carried out with salicylaldehyde and *p*-methoxysalicylaldehyde and 5 : 6-dimethoxyhydrindone.

The pyranol derivatives thus produced may also be obtained by the action of alcoholic hydrochloric acid on the corresponding *o*-hydroxybenzylidene-1-hydrindones and, conversely, the latter are again produced from the pyranols by the action of alcoholic potash. The following example will serve as an illustration of these important changes:



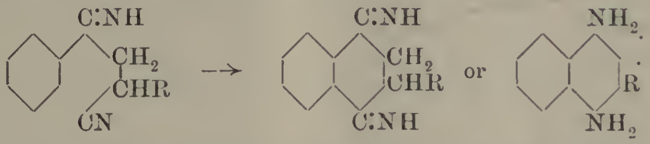
The authors wish to reserve, for a short time, the further investigation of the above and similar condensations.

109. "Arsenic di-iodide." By John Theodore Hewitt and Thomas Field Winmill.

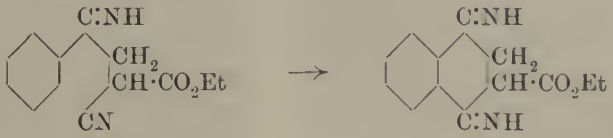
The authors have prepared and analysed the arsenic di-iodide described by Bamberger and Philipp (*Ber.*, 1881, **14**, 2643). The molecular weight determined by the elevation of boiling point in carbon disulphide solution shows the compound to have the formula As_2I_4. The substance is, however, useless for the preparation of aromatic analogues of cacodyl, since the only product isolated from the action of magnesium phenyl bromide is triphenylarsine. Pyridine decomposes the compound immediately with liberation of arsenic.

110. "The formation and reactions of imino-compounds. Part IV. The formation of 1 : 4-naphthylenediamine from ethyl γ-imino-α-cyano-γ-phenylbutyrate." By Jocelyn Field Thorpe.

In continuation of the work already published in Parts II and III of this series it was shown that derivatives of benzene having a side-chain of three carbon atoms substituted at the α-carbon atom by a nitrile group and at the γ-carbon atom by an imino-group pass on treatment with cold concentrated sulphuric acid into derivatives of 1 : 4-naphthylenediamine, ring formation taking place between the ortho-hydrogen atom of the benzene ring in respect to the side-chain and the carbon atom of the nitrile group. The general formula for this reaction can therefore be represented as follows:

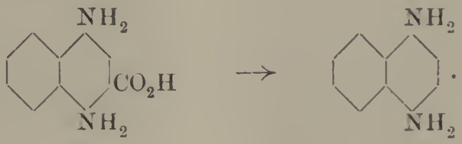


Ethyl γ-imino-α-cyano-γ-phenylbutyrate (1) passes on treatment with cold concentrated sulphuric acid into ethyl 1 : 4-naphthylenediamine-3-carboxylate (2):



(1). (2).

This ethyl salt yields 1 : 4-naphthylenediamine-3-carboxylic acid (3) on hydrolysis, from which 1 : 4-naphthylenediamine (4) can be prepared on heating at 200° in a current of hydrogen:



(3). (4).

111. "Mercury derivatives of pseudo-acids containing the group ·CO·NH·." By Samuel James Manson Auld.

Unlike cyanuric acid which forms two isomeric mercuric salts (Hantzsch, *Ber.*, 1902, 35, 2717), all the pseudo-acids containing the group ·CO·NH· examined have given only one derivative, in all cases an *N*-salt containing the group ·CO·Nhg·. Some of these *N*-mercury salts act as "mercury acids" and form alkali salts. Violuric acid, for instance, forms a series of coloured alkali mercuriviolurates, which can be obtained both in the hydrated and anhydrous states. The pseudo-acids examined include uric acid and its alkyl derivatives, *ψ*-uric acid, methyluracyl, violuric and dimethylvioluric acids, saccharin, benzoylcyanamide, and carbostyril.

112. "The influence of substitution in the nucleus on the rate of oxidation of the side-chain. III. Oxidation of the nitro- and chloronitro-derivatives of toluene." By Julius Berend Cohen and Henry James Hodsman.

The authors have studied the rate of oxidation of the nitro- and chloronitro-toluenes, the same method being employed as that previously described (*Trans.*, 1904, **85**, 174, 1622). Excluding the 4-chloro-2-nitrotoluene, which occupies an exceptional position in the series, the general result of the oxidation of the ten isomeric chloronitrotoluenes may be summarised as follows. The compounds with the nitro-group in the ortho-position are least oxidised, those with the nitro-group in the para-position are most oxidised, whilst the meta-compounds stand midway between the two. The same result is obtained with the three isomeric nitrotoluenes. The position occupied by 4-chloro-2-nitrotoluene appears to depend on the length of time during which the substance is in contact with the oxidising agent, the quantity of acid formed varying inversely with the time of oxidation. This has been explained by showing that in all the *o*-nitro-compounds the acid first formed undergoes further oxidation and that this is especially the case with the 4-chloro-2-nitro-compound. The result is that the quantity of acid as well as the total yield of products is low, in other words, the more protracted the oxidation, the more of the acid, first formed, is destroyed.

The authors also described the preparation of 3-chloro-2-nitrotoluene which was originally obtained by one of them in conjunction with H. G. Bennett, so that all the isomeric chloronitrotoluenes are now known.

113. "The reducibility of magnesia by carbon." Preliminary note. By Roland Edgar Slade.

Three distinct methods were attempted for establishing the reducibility of magnesia by carbon. The first consists in heating magnesia and carbon together in an enclosed furnace, with arc or resistance heating, and collecting and analysing the gaseous products of reaction; considerable quantities of carbon monoxide and some carburised magnesium were in this way obtained.

The second method is an application of that employed by R. S. Hutton and J. E. Petavel (*Proc. Roy. Soc.*, 1907, A **79**, 155) for investigating the reduction of alumina, and consists in employing a bath of molten electrolytic copper as a solvent and condenser for the metal vapour.

These experiments were carried out in carbon tube furnaces and in crucibles heated under the electric arc; alloys of copper and magnesium were obtained at temperatures as low as 1700°. In the carbon tubes the sublimed magnesia also reacts with the heated walls of the tubes, from which a powder containing carburised magnesium can be collected on cooling.

The third method has not up to the present proved successful, but consists in heating a mixture of magnesia and carbon to known temperatures in a current of nitrogen gas, the product being examined for nitride. The temperature of reduction of magnesia seems to be above the limit of temperature at which the nitride is stable.

The two methods which have furnished a positive result give independent confirmation of the recent experiments of Lebeau (*Compt. rend.*, 1907, **144**, 799). Whereas this author considers that the reduction only occurs at or above the boiling point of magnesia when the vapour of carbon and magnesia come in contact, the present research seems to show that the reaction can take place at temperatures below the melting point of this oxide.

114. "The reaction between organo-magnesium halides and nitro-compounds." Preliminary note. By Robert Howson Pickard and Joseph Kenyon.

Aromatic nitro-compounds react very vigorously with an organo-magnesium halide in ethereal solution.

p-Nitrotoluene thus forms an indefinite amorphous yellow *compound*, which, when treated with acids, yields principally *p*-nitrosotoluene, *p*-tolylhydroxylamine, *pp'*-azoxytoluene (probably by the interaction of the two former compounds), and *p*-toluidine.

The authors wish to reserve for a time the study of this new reaction.

115. "A method for the determination of the equilibrium in aqueous solutions of amines, pseudo-acids and bases, and lactones." By Tom Sidney Moore.

The compounds mentioned in the title resemble each other in that their aqueous solutions contain, in addition to ions, two non-ionised forms. The relations may be represented by the equations:

$$\text{For a pseudo-acid: } \mathrm{H{\cdot}X{:}O} \underset{}{\overset{(1)}{\rightleftarrows}} \mathrm{X{\cdot}OH} \overset{(2)}{\rightleftarrows} \mathrm{XO'} + \mathrm{H^{\cdot}}$$

$$\text{For an amine: } \mathrm{NX_3} + \mathrm{H_2O} \overset{(1)}{\rightleftarrows} \mathrm{NX_3H{\cdot}OH} \overset{(2)}{\rightleftarrows} \mathrm{NX_3H^{\cdot}} + \mathrm{OH'}$$

The reaction constants of the reactions (1) and (2) cannot in general be determined directly, although their determination is a matter of considerable importance; for the constant of reaction (2) is the true ionisation constant of the acid or base; and the constant of reaction (1) represents the relation between the two forms of the pseudo-acid, or between the amine and its hydroxide as the case may be.

The author showed that these constants, as well as their temperature coefficients, may be calculated from the results of measurements of the partition of the substance between water and another solvent, and of the "apparent" ionisation constant (as calculated from the electrical conductivity, or from degree of hydrolysis of salts) at different temperatures.

116. "The 'true' ionisation constants, and the hydration constants of piperidine, ammonia, and triethylamine." By Tom Sidney Moore.

The equations developed in the preceding paper were applied to the results of the partition experiments of Hantzsch and Sebaldt, Hantzsch and Vagt, and of Dawson and McCrae, and the values of the true ionisation constants (k_1) and of the hydration constants (k_2) determined for different temperatures.

$$k_2 C_{\mathrm{NX_3}} = C_{\mathrm{NX_3HOH}}$$
$$\text{and } k_1 C_{\mathrm{NX_3HOH}} = C^{\mathrm{NX_3H^{\cdot}}} \times C_{\mathrm{OH'}}.$$

At 20° the results were:

	$k_1 \times 100$.	k_2.
Piperidine	0·156	2·83
Ammonia..................	0·0052	0·56
Triethylamine	0·064	1·86

Further, the heat of neutralisation of the three bases and the heat of solution of ammonia were calculated and found to agree satisfactorily with the experimental values.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Alessandri, *P. E.* Merceologia tecnica. Vol. I. Materie prime greggie e semi-lavorate di uso commerciale ed industriale. Vol. II. Prodotti chimici inorganici ed organici. pp. xi + 530, xi + 515. ill. Milano 1907. (*Recd.* 9/5/7.) From the Publisher: Ulrico Hoepli.

Lister Institute of Preventive Medicine. Collected papers, No. 3. London 1906. (*Recd.* 15/5/7.) From the Director.

Matthews, *J. Merritt.* The textile fibres: their physical, microscopical, and chemical properties. 2nd edition. pp. viii + 480. ill. New York 1907. (*Recd.* 6/5/7.)
From the Publishers: Messrs. John Wiley and Sons.

National Physical Laboratory. Collected researches. Vol. II. pp. 310. ill. [London 1907.] (*Recd.* 1/5/7.) From the Director.

—— Report for the year 1906. pp. 61. ill. Teddington 1907. (*Recd.* 1/5/7.) From the Director.

Roth, *W. A.* Physikalisch-chemische Übungen. pp. xii + 174. ill. Hamburg 1907. (*Recd.* 25/4/7.)
From the Publisher: Leopold Voss.

Settimj, *Luigi.* Caoutchouc e gutta-percha. pp. xvi + 253. ill. Milano 1907. (*Recd.* 9/5/7.) From the Publisher: Ulrico Hoepli.

Sheppard, *S. E.*, and **Mees,** *C. E. Kenneth.* Investigations on the theory of the photographic process. pp. x + 342. ill. London 1907. (*Recd.* 10/5/7.) From the Authors.

Van Nostrand's Chemical Annual, 1907. A handbook of useful data. Edited by *John C.* **Olsen.** pp. x + 496. London 1907. (*Recd.* 6/5/7.)
From the Publishers: Messrs. A. Constable & Co.

Vogel, *Hermann Wilhelm.* Photochemie und Beschreibung der photographischen Chemikalien. Fünfte Auflage, bearbeitet von *Ernst* **König.** pp. xi + 376. ill. Berlin 1906. (*Recd.* 13/5/7.)
From the Publisher: Gustav Schmidt.

II. *By Purchase.*

Allen, *Alfred H.* Commercial organic analysis. 3rd. Edition. Vol. II. Part III. Acid derivatives of phenols, aromatic acids, resins, and essential oils. Revised by the Author and *Arnold Rowsby* **Tankard.** pp. xiii + 547. London 1907. (*Recd.* 22/4/7.)

Lassar-Cohn. Arbeitsmethoden für organisch-chemische Laboratorien. Spezieller Teil: Erste Hälfte. Vierte Auflage. pp. 864. Hamburg 1907. (*Recd.* 15/5/7.)

Wedekind, *Edgar.* Zur Stereochemie des fünfwertigen Stickstoffes. Zweite Auflage von *Emil* **Fröhlich.** pp. 93. Leipzig 1907. (*Recd.* 15/5/7.)

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Saturday, 8th June, 1907.

Those Fellows who received grants in June, 1906, or whose grants, allotted in June of previous years, have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Saturday, 1st June, next.

On Thursday, June 13th, 1907, Professor J. B. Farmer, F.R.S., will deliver a discourse entitled "Some Borderline Problems in Botany."

ERRATUM.

1907. P. 137, line 12 from top, *for* "*N*/100" *read* "*N*/1000."

At the next Ordinary Meeting, on **Thursday**, June **6th**, 1907, at **8.30** p.m., the following papers will be read :

"The relation between absorption spectra and chemical constitution. Part VII. Pyridine and some of its derivatives." By F. Baker and E. C. C. Baly.

"The interaction of methylene chloride and the sodium derivative of ethyl malonate." By F. Tutin.

"Molecular weight of β-naphthol in solution in solid naphthalene." By E. P. Perman and J. H. Davies.

"Synthesis of hexatriene derivatives." Preliminary notice. By I. Smedley.

"The constitution of the diazo-compounds." By J. C. Cain.

"*p*-Cresol sulphoxide and sulphide." By S. Smiles and T. P. Hilditch.

"*p*-Dioxyphenylsulphoxide." By S. Smiles and A. W. Bain.

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Issued 18/6/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 327.

Thursday, June 6th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. A. T. Cameron, G. Fowles, S. W. Smith, and J. W. Yates were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Frank Buckney, B.A., 51, Highbury Park, N.
William Hay, Holton House, Beverley Road, Hull.
George Joseph Saunders, B.E., School of Mines, Charters Towers, Queensland, Australia.
David Willott, B.Sc., Rosedale, Thorncroft Road, Sutton, Surrey.
Hubert Arthur Wootton, B.A., B.Sc., 20, Great College Street, Westminster, S.W.

Of the following papers, those marked * were read :

*117. "The relation between absorption spectra and chemical constitution. Part. VII. Pyridine and some of its derivatives." By Frank Baker and Edward Charles Cyril Baly.

The authors have made a spectroscopic examination of pyridine and its substitution products, with the object of determining the influence of the nitrogen atom and also the constitution of the pyridones. It was shown how the nitrogen atom tends to restrain the motions of the ring, this restraint being very much lessened by the addition of acid to the solutions. A very similar effect is produced by the substitution by chlorine, inasmuch as the basicity of the nitrogen is thereby considerably reduced.

In the case of the oxypyridines, the α- and β-compounds were shown to be true pyridones, whilst the β-isomeride possesses the hydroxylic configuration.

*118. "The interaction of methylene chloride and the sodium derivative of ethyl malonate." By Frank Tutin.

The reaction which takes place when methylene chloride is heated with an alcoholic solution of the sodium derivative of ethyl malonate has been studied, and the following three crystalline by-products resulting from the condensation were examined.

1. A sodium salt crystallising from alcohol in yellow leaflets.
2. An *acid* crystallising in needles, which melt at 132°.
3. An *acid* obtained in small needles, which are insoluble, or nearly so, in all solvents.

The yellow sodium salt was obtained by Perkin and Prentice (*Trans.*, 1891, 59, 991), but was not further examined by them. It has the formula $C_{15}H_{21}O_8Na$, and yields a liquid *acid*, $C_{14}H_{21}O_6\cdot CO_2H$, which gives a violet coloration with ferric chloride. On hydrolysis, this acid first gives an *acid* melting at 305°, but, when completely hydrolysed, yields a *tetracarboxylic acid*, $C_6H_8(CO_2H)_4$ (m. p. 138—139°). The latter compound, although melting at the same temperature as *cis-cyclo*hexane-1 : 2 : 4 : 5-tetracarboxylic acid, is not identical with it.

The substance melting at 132° possesses the formula

$$C_{18}H_{24}O_6(CO_2H)_2,$$

and, on hydrolysis, yields an *acid* melting at 306°.

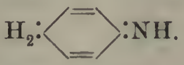
The insoluble substance is hydrolysed by sodium carbonate, giving a *sodium* salt, $C_{32}H_{35}O_{20}Na_3,6H_2O$, crystallising in white needles ; the corresponding *potassium* salt is insoluble and anhydrous. The *acid*, $C_{29}H_{35}O_{14}(CO_2H)_3$, obtained from these salts crystallises in leaflets melting at 200°.

*119. "The constitution of the diazo-compounds."

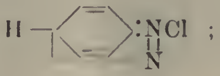
By John Cannell Cain.

None of the formulæ hitherto proposed for the diazo-salts can account for the great ease with which such compounds lose their diazo-nitrogen. Nitrogen attached to the benzene ring, as, for example, in the case of aniline, is readily eliminated only by oxidation, and

Ostrogowich and Silbermann have recently shown that in this process aniline probably assumes the tautomeric form :



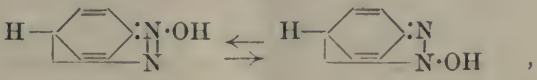
As the diazotisation process closely resembles this reaction the author proposed for diazobenzene salts (chloride) the quinonoid formula.



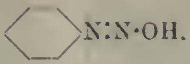
this bears much analogy to the formula of quinonechloroimide, which also loses nitrogen on boiling with water.

The new formula explains why, in compounds where the atom in the para-position to the amino-group is already saturated, no diazo-salt can be formed, thus, for example, *ac*-tetrahydronaphthylamine and 4-aminoquinoline yield no diazo-salts. For a similar reason no aliphatic diazo-chlorides are known.

The corresponding formula for the diazohydroxide may, unlike the chloride, give rise to two tautomeric forms :



the latter of which represents the constitution of the normal or *syn*-diazo-compounds and is closely related to the formula for the *iso-* or *anti*-compounds :



As these formulæ fully explain the reactions of the diazo-compounds the stereochemical theory is rendered unnecessary.

The following recommendations as to nomenclature were suggested.

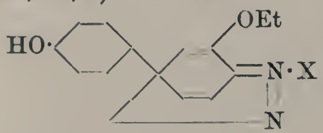
(i) The word "diazonium" should be retained for the diazo-salts.

(ii) The normal or *syn*-metallic diazo-compounds should be called normal diazo-oxides or diazo-oxides.

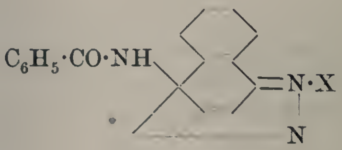
(iii) The *iso-* or *anti*-compounds should be called *iso*-diazo-oxides.

Discussion.

Dr. Morgan said that the retention of the quinquevalency of the salt forming nitrogen atom and the representation of the mobility of the diazo-group N_2 by means of the doubly linked attachment to the aromatic nucleus were both strong arguments in favour of the new formula for diazonium salts. It must, however, not be forgotten that other types of diazo-derivatives, the diazoamines and the acyl-*p*-diazoimides, for example, also readily give up their diazo-nitrogen, and it still remained to be seen whether this formulation could be extended to those cases. The new formula represented diazonium salts as substances of a quinonoid type, but so long as the radicle in the para-position to the diazo-nitrogen was hydrogen or a simple saturated group (methyl, methoxyl, &c.) there was no development of colour; when, however, this hydrogen was replaced by a complex aromatic group then the compound exhibited colour. The stable yellow diazo-salts having the general formula I were a case in point (Cain, *Trans.*, 1905, **87**, 5).



(I.)



(II.)

Having been engaged for some time in the investigation of compounds of this nature he hoped, in conjunction with Mr. Wootton, to bring forward at the next meeting a complete series of coloured stable diazo-salts (formula II) derived from *p*-aminobenzo-α-naphthalide. A formula such as that advocated by Dr. Cain afforded a satisfactory explanation of the properties and reactions of these substances.

Dr. Hewitt drew attention to the coloured diazonium salts which had been obtained by different chemists. Some of the earliest to be isolated were those derived from *p*-semidine bases; these were not merely coloured, but Jacobson found that they were remarkably stable to heat. The diazonium salts prepared by Dr. Cain and Dr. Morgan were coloured and stable, and like Jacobson's compounds could be represented with a true quinonoid structure.

Dr. Lapworth pointed out that if, as this ingenious formulation indicated, one of the nitrogen atoms in the diazo-group was attached to the carbon atom in the para-position to that linked to the other nitrogen atom, it had to be assumed that the new carbon-nitrogen linking was very much more unstable than that which represented the normal link between the diazo-group and the benzene nucleus. Yet the former was represented as a single bond, whilst a double one was assumed in the latter case to account for its instability. Had Dr. Cain any explanation of the fact that during the changes of diazo-compounds nitrogen had never been found at the point where his formula suggested it should, at least occasionally, be discovered?

Dr. Cain, in reply to Dr. Lapworth, pointed out that the linking in the group N·CH was usually a very unstable one, and in the present case was largely influenced by the condition of the linkings in the benzene nucleus.

*120. "Dibromoaminoazobenzene." By John Theodore Hewitt and Norman Walker.

A dibromoaminoazobenzene, produced by the action of bromine on an aqueous alcoholic solution of aminoazobenzene, has been described by Berju (*Ber.*, 1884, **17**, 1403), who gives the melting point as 152° and has not determined the constitution of the compound. The present authors find that the action of bromine on an acetic acid solution of aminoazobenzene in presence of sodium acetate gives benzeneazo-*oo*-dibromoaniline, m. p. 168°. This forms the chief constituent of the product obtained by Berju's method. The *diacetyl* derivative melts at 137°, the *dibenzoyl* derivative at 229°. The constitution was determined by reduction with sodium hyposulphite, the 2 : 6-dibromo-1 : 4-phenylenediamine of m. p. 138° (E. Noelting, E. Grandmougin, and O. Michel, *Ber.*, 1892, **25**, 3334) being isolated.

121. "Phenol *p*-sulphoxide." By Samuel Smiles and Alexander William Bain.

The authors described the preparation of *phenol* p-*sulphoxide*, and showed that its properties differ widely from those assigned by Schall and Uhl (*Ber.*, 1892, **25**, 1893) to the substance obtained by the action of fused alkali hydroxide on the dyestuff rubbadin, and to which they attributed the same constitution. The condensation of phenol *p*-sulphoxide with salicylic acid yields *di*-p-*hydroxyphenylsalicylthetine*.

122. "*p*-Cresol sulphoxide and sulphide." By Samuel Smiles and Thomas Percy Hilditch.

These substances were obtained during an investigation of the action of dehydrating agents on ortho-hydroxysulphoxides. p-*Cresol sulphoxide* is formed by the interaction of *p*-cresol, aluminium chloride, and thionyl chloride. It crystallises in needles, which melt at 191° and are soluble in alcohol or hot water; it dissolves in strong sulphuric acid with a deep blue colour, but, unlike the other hydroxysulphoxides which have been prepared, this colour is not discharged by the addition of a phenolic ether (Smiles and Le Rossignol, *Trans.*, 1906, **89**, 701). When the blue solution is mixed with water a pink solid is precipitated. The same substance was obtained by boiling the sulphoxide with phosphoryl chloride; it is soluble in aqueous alkali hydroxide, and the yellow solution on shaking with benzoyl chloride yields a colourless benzoyl derivative. The substance also furnishes a platinichloride. On account of the amorphous character of these compounds the investigation has been abandoned.

*Dibenzoyl-*p-*cresol sulphoxide* melts at 173°.

p-*Cresol sulphide* was prepared by reduction of the sulphoxide; it crystallises from a mixture of acetic acid and water in colourless needles, which melt at 101—103°.

123. "Molecular weight of β-naphthol in solution in solid naphthalene." By Edgar Philip Perman and John Hughes Davies.

The vapour pressures of solid naphthalene, of β-naphthol, and of isomorphous mixtures of these substances, at 70°, were estimated by aspirating a known volume of air through a glass spiral containing the solid, and determining the loss of weight. The mean vapour pressures obtained were: naphthalene, 3·751 mm. of mercury; β-naphthol, 0·1134 mm.; solid solution of 5 parts of β-naphthol to 100 parts of naphthalene, 3·592 mm.; 10 parts to 100, 3·476 mm.; 15 parts to 100, 3·380 mm. The corresponding molecular weights calculated are 151, 175, and 194 respectively. It is concluded that in dilute solutions, β-naphthol has the same molecular weight as in the gaseous state, whilst it associates in more concentrated solutions.

124. "Synthesis of hexatriene derivatives." (Preliminary note.) By Ida Smedley.

Experiments undertaken with the object of preparing a series of hexatriene derivatives by the elimination of chlorine from αα-dichloro-γ-alkyl-propylenes having led to unsuccessful results (*Proc.*, 1906, 22, 158), the method adopted by Van Romburgh and Dorssen (*Proc. K. Akad. Wetensch. Amsterdam*, 1905, 8, 565) for the preparation of the simplest member of the series, C_6H_8, was applied. The formate of dihydrocinnamoin was prepared; this readily resinifies and does not therefore afford a convenient method of synthesis of the pure diphenylhexatriene, $C_6H_5\cdot CH{:}CH\cdot CH{:}CH\cdot CH{:}CH\cdot C_6H_5$.

This hydrocarbon may, however, be obtained by the condensation of phenyl*iso*crotonic acid with cinnamaldehyde in the presence of acetic anhydride. From acetone or benzene solution, it is deposited in pale yellow crystals, melting at 194°. The dilute benzene solution exhibits a remarkable blue fluorescence.

125. "The reduction of aromatic nitro-compounds to azoxy-derivatives in acid solution." By Bernhard Flurscheim and Theodor Simon.

According to a general rule, azo- and azoxy-compounds are formed when aromatic nitro-compounds are reduced in alkaline solution, but never in presence of free mineral acids. One of the authors has, however, previously shown (*J. pr. Chem.*, 1905, [ii], 71, 497) that it is often possible to isolate the azoxy-compound in acid solution as well, sometimes even in theoretical yield, and that the above-mentioned law must be abandoned.

It was, however, further necessary to determine the conditions which favour the formation of azoxy-products or prevent it. To render this possible, an exact separation of the substances, resulting from the reduction of nitro-compounds by means of stannous chloride and hydrochloric acid in alcoholic solution, had to be effected. To this end the first part of the present research has been devoted, and the authors have succeeded in separating quantitatively the products of reduction, namely, amines, aminophenols, azoxy- and aminoazoxy-compounds from each other and from the unattacked nitro-compounds.

With the help of these new methods, more than sixty reductions have been carried out, with varying quantities of acid, and under changing conditions. The following nitro-compounds have been used: nitrobenzene, *m*-dinitrobenzene, 2 : 4-dinitrotoluene, 4 : 6-dinitro-*m*-xylene, 1-chloro-2 : 4-dinitrobenzene, 1-bromo-2 : 4-dinitrobenzene, 3 : 5-dichloro-4-bromonitrobenzene, 2 : 4-dinitrodiphenylamine, and *p*-nitrobenzaldehyde. The chief results may thus be briefly summarised:

(1) Reduction in acid, neutral, and alkaline solutions proceeds in accordance with Haber's hypothesis, nitroso- and hydroxylamino-derivatives being successively formed.

(2) The formation of azoxy-compounds during reduction is due to a condensation of hydroxylamino- and nitroso-derivatives.

(3) This condensation can only take place when the residual affinity of the tervalent nitrogen atom in the hydroxylamino-compound is not saturated.

(4) Such saturation taking place, when salts are formed anything favouring dissociation of these salts, for instance, negative substituents in the nucleus, also favours condensation, whilst increasing quantities of acid tend to prevent it.

(5) A diminution in the velocity of reduction favours condensation.

(6) Ortho-substituents diminish tho velocity both of reduction and condensation; these being opposite influences, the influence of ortho-substituents on the formation of azoxy-compounds varies with their nature, some favouring condensation (bromine, &c.), others tending to prevent it (methyl, &c.).

All the results can be depicted graphically, the percentage of azoxy-compounds produced forming for each substance a curve falling with increasing quantities of acid used. In the absence of ortho-substitution, nitro-compounds with strongly negative nucleus substituents yield curves running above those obtained with less negative radicles.

126. "Action of selenium and tellurium on arsine and stibine."

By Francis Jones.

In continuance of his previous work (*Journ. Chem. Soc.*, 1876, 641), where it was shown that sulphur decomposes arsine and stibine in presence of light in accordance with the equation $2SbH_3 + 6S = Sb_2S_3 + 3H_2S$, the author has now investigated the action of these hydrides on the elements analogous to sulphur, namely, selenium and tellurium, in presence and absence of light and at 100°.

The results are shown in the following table:

(a). *In sunlight.*

Element.	Hydride.	Result.	Element.	Hydride.	Result.
Sulphur	SbH_3	Reacts easily	Sulphur ..	AsH_3	Reacts slowly
Selenium.....	SbH_3	Reacts easily	Selenium ...	AsH_3	Reacts
Tellurium ...	SbH_3	Reacts	Tellurium ...	AsH_3	Reacts

(b). *At* 100°.

Sulphur	SbH_3	Reacts slowly	Sulphur ...	AsH_3	Reacts slowly
Selenium......	SbH_3	Reacts slowly	Selenium ...	AsH_3	No action
Tellurium ...	SbH_3	Reacts very slowly	Tellurium ...	AsH_3	No action

(c). *In the dark.*

Sulphur	SbH_3	No action	Sulphur ...	AsH_3	No action
Selenium. ..	SbH_3	Reacts slightly	Selenium ...	AsH_3	No action
Tellurium ..	SbH_3	No action	Tellurium ...	AsH_3	No action

It was previously shown that the facility of the decomposition of the hydrides increases with the rise in the molecular weight of these gases, phosphine being very slowly decomposed, arsine more rapidly, and stibine very rapidly. It is now found that the action of these hydrides on sulphur, selenium, and tellurium corresponds with the rise in the atomic weights of these elements, stibine being readily decomposed by sulphur, more slowly by selenium, and still more slowly by tellurium. An exception was noticed in the case of stibine, which acts on selenium even in the dark.

In the course of the investigation it was observed that arsine reacts with solution of lead acetate, producing a black precipitate, probably an arsenide of lead, the composition of which varied in different preparations.

127. "The double nitrites of mercury and the alkali metals." By Prafulla Chandra Rây.

Mercuric nitrite forms a series of double salts with the nitrites of potassium, sodium, and lithium in which 1 molecule of the former combines with 1, 1½, 2, 3, and 4 molecules of the latter.

128. "Silver-mercuroso-mercuric hydroxynitrates and the isomorphous replacement of univalent mercury by silver." By Prafulla Chandra Rây.

When a solution containing mercuroso-mercuric nitrite and silver-mercuric nitrite is allowed to evaporate spontaneously, a series of silver-mercuroso-mercuric hydroxynitrates crystallises out. In each of these salts a part of the mercurous mercury is isomorphously replaced by silver.

129. "The molecular weights of amides in various solvents." (Preliminary note.) By Andrew Norman Meldrum and William Ernest Stephen Turner.

In the course of an investigation into the molecular condition of typical amides in various solvents, the authors have found that the molecules of trichlorolactamide, of benzanilide, and of salicylamide are associated in benzene solution even at the boiling point, and those of benzamide in benzene, in chloroform, and in acetone solution.

No case of association in alcohol solution has been discovered, acetamide, monochloroacetamide, and benzamide giving normal results. In the case of amides derived from stronger organic acids than these, the "molecular weights" in alcohol are abnormally low.

The results obtained with water as solvent are unexpected, association being found in at least three cases, acetamide, benzamide, and salicylamide.

130. "Some experiments on the oxidising action of hydrogen peroxide." (Preliminary note.) By William Henry Perkin, jun.

During the course of researches on the constitution of brazilin and hæmatoxylin, the observation was made that certain of their derivatives, when treated with hydrogen peroxide (30 per cent.) and acetic acid, were readily oxidised with the formation of new substances the investigation of which will, it is hoped, throw much light on the constitutions of these important natural colouring matters.

Thus, for example, *brazilein*, $C_{16}H_9O_2(OH)_3$, is under these conditions converted into a substance, $C_{16}H_{14}O_9$, which crystallises in brown needles and *trimethylbrazilein*, $C_{16}H_9O_2(OMe)_3$, yields a colourless crystalline substance, $C_{19}H_{20}O_8$, which melts at 218° with decomposition. The detailed description of these and other similar oxidation experiments of brazilein and hæmatein is reserved for a subsequent communication.

Experiments of a more general nature seem to indicate that hydrogen peroxide may prove to be a reagent of considerable importance, especially in connexion with analytical researches.

It appears, for example, to react readily with *αα*-diketones and generally with substances possessing quinonoid structure.

Benzil is readily attacked, when its suspension in a little acetic acid is mixed with hydrogen peroxide and warmed on the water-bath, and the product contains large quantities of benzoic acid and a pale yellow oil which has not yet been investigated.

When *phenanthrenequinone* (5 grams) suspended in glacial acetic acid (15 c.c.) and hydrogen peroxide (5 c.c.) is heated at 90—95°, the crystals soon dissolve and the solution, on dilution with water, deposits 5 grams of pure diphenic acid, a method which is by far the most convenient for the preparation of this important acid.

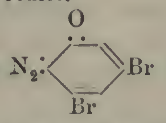
Aurin, under similar conditions, is very readily attacked by hydrogen peroxide with formation of *p*-hydroxybenzoic acid and benzoquinone. Obviously the aurin is, in the first place, oxidised to *p*-hydroxybenzoic acid and quinol,

$$(C_6H_4{\cdot}OH)_2C{:}C_6H_4{:}O + 2H_2O_2 = C_6H_4(OH){\cdot}CO_2H + 2C_6H_4(OH)_2,$$

and the latter is then further oxidised to benzoquinone. It will be shown, in a later communication, that this decomposition is of importance in connexion with the determination of the constitution of brazilein and hæmatein. The special value which appears to attach to hydrogen peroxide lies in the fact that it can be employed to oxidise phenolic substances, like brazilein and aurin, without the usual and often very laborious routine of protecting the hydroxyl groups by methylation. Experiments are in progress with the view of determining the special conditions under which hydrogen peroxide may be employed with success. The presence of acetic acid appears to be generally advantageous, but other solvents may be employed, and, in some cases, the oxidation of phenolic substances has been found to proceed well in alkaline solution.

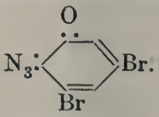
131. "Action of hydroxylamine on *o*-benzoquinonediazides (*o*-diazophenols). 3:5-Dibromo-*o*-azoiminobenzoquinone (4:6-dibromo-2-hydroxyphenylazoimide)." (Preliminary note.) By Kennedy Joseph Previté Orton, William Charles Evans, and Emrys Morgan.

The simple means of preparing the benzoquinonediazides, especially the halogen-*o*-benzoquinonediazides, from the *s*-trihalogendiazonium salts of weak acids (Orton, *Trans.*, 1903, **83**, 796), a reaction in which a halogen atom is replaced by a hydroxyl group, has permitted of a detailed study of the behaviour of these substances with a number of reagents. The recent appearance of a paper by Forster and Fierz on "Aromatic Azoimides" (*Trans.*, 1907, **91**, 855), in which is described the preparation of *p*-hydroxyphenylazoimide from *p*-diazophenol and hydroxylamine, shows that it is advisable to make a preliminary announcement of one of the authors' results.

3:5-Dibromo-*o*-benzoquinonediazide,  (Orton, *loc. cit.*),

reacts very readily with hydroxylamine in alcohol solution, the reaction being completed if the hydrogen chloride of the hydroxylamine hydrochloride is replaced by a weak acid or neutralised by a base. On adding water to the resulting alcoholic solution, the *azoimide*, the yield of which is quantitative, separates in yellowish-brown needles melting at 98°, the molten material decomposing slowly a few degrees above the melting point. The azoimide is readily soluble in all organic solvents except light petroleum, and is slightly soluble in water, to which it imparts a bright yellow colour. It has a decided acid character, dissolving in solutions of alkali hydroxides and carbonates. In anhydrous solvents, it also appears to combine directly with hydrogen chloride. The azoimide dissolves in sulphuric acid with the evolution of nitrogen, the solution acquiring a deep magenta colour. With bromine it yields a tetrabromoaminophenol.

Inasmuch as the azoimido-group does not in itself confer colour, whilst this compound is deeply coloured, the authors are inclined to give it provisionally a quinonoid structure, thus :



3 : 5-Dibromo-2-nitro-*p*-benzoquinonediazide and 4-bromo-*o*-naphthaquinonediazide (Orton, *loc. cit.*) react similarly with hydroxylamine.

132. "Oxime formation and decomposition in presence of mineral acids." By Arthur Lapworth.

The conversion of stable hydroximido-compounds into the corresponding ketones or aldehydes is as a rule to be effected by the use of hydrochloric acid in presence of formaldehyde. *iso*Nitrosocamphor, for example, gives an excellent yield of camphorquinone, and even camphoroxime may be partially converted into camphor by this method, which appears to be the most general hitherto discovered. The formaldehyde is converted into formic acid in the process, while the nitrogen of the oxime appears mainly as ammonium chloride.

The hydrolytic action of mineral acids on oximes appears to be a reversible one, which is possibly, in part, the explanation of the favourable influence of the formaldehyde in the above instances. When hydroxylamine, formaldehyde, and concentrated hydrochloric acid are heated together, formic acid, ammonium chloride, and methylammonium chloride are formed. When benzaldehyde is substituted for formaldehyde, benzaldoxime and, sometimes, benzonitrile, are formed. Camphorquinone yields camphorimide, and camphor gives campholenonitrile.

133. "Note on the constituents of the seeds of the Para rubber tree (*Hevea brasiliensis*)." By Wyndham Rowland Dunstan.

The kernels of the seeds of the Para rubber tree (*Hevea brasiliensis*) were examined at the Imperial Institute in 1902, and found to contain about 50 per cent. of a fixed oil, having a specific gravity 0·9302 at 15°, saponification value 206·1, and iodine value 128·3. Like linseed oil, to which it bears considerable resemblance, this oil "dried" to a transparent varnish on exposure to air, and will probably be of commercial value for the same [purposes. In the future there is likely to be an enormous production of these seeds which will not be required for planting, and their commercial utilisation is, therefore, a matter of importance (*Bull. Imp. Inst.*, 1903, 1, 156, and 1904, 2, 22).

The seed kernels, when ground with water, evolved small quantities of hydrocyanic acid and acetone, whence it appears that a cyanogenetic glucoside is present, similar to if not identical with the phaseolunatin first obtained from the beans of *Phaseolus lunatus* (Dunstan and Henry *Proc. Roy. Soc.*, 1903, **72**, 285), and subsequently isolated from flax and cassava (Dunstan, Henry, and Auld, *ibid.*, 1906, **78**, 145).

A mixture of enzymes was prepared from the seeds which possessed the property of hydrolysing the oil present and also olive oil. These enzymes probably include, besides a lipase-like enzyme, one capable of decomposing the cyanogenetic glucoside, since the kernels yield hydrocyanic acid by mere contact with water. The nature of the fixed oil of the cyanogenetic glucoside and of the enzymes is being fully investigated.

Van Romburgh has shown (*Ann. Jard. Bot. Buitenzorg*, 1899, **16**, 15) that the leaves of *Hevea brasiliensis* also yield hydrocyanic acid and acetone when crushed with water, and Harrison has recorded the production of hydrocyanic acid under similar conditions from the seeds of the related species *Hevea pauciflora* and *Hevea confusa* (*Rep. Govt. Lab. Brit. Guiana*, 1896–1902, Part II, p. 11).

It is hoped that sufficient material will be obtainable to enable the question to be settled as to whether these related plants, as well as *Hevea brasiliensis*, contain phaseolunatin, as seems probable.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Chemical Society. Chemical Abstracts. Edited by *William A.* **Noyes** [and others]. Vol. I, &c. New York 1907+. (*Reference.*) From the Society.

Jahres-Bericht über die Untersuchungen und Fortschritte auf dem Gesammtgebiete der Zuckerfabrikation. Vols. I to IV. 1861–64. Edited by *C.* **Scheibler** and *K.* **Stammer.** Breslau 1863–65.

From R. A. Scott Macfie, Esq.

Rose, *Heinrich.* Ausführliches Handbuch der analytischen Chemie. Band I. Die Lehre von den qualitativen chemisch-analytischen Untersuchungen. Band II. Die Lehre von den quantitativen chemisch-analytischen Untersuchungen. pp. xiv + 968, vi + 1070 + 125. Braunschweig 1851. (*Reference.*)

Bequeathed by the late Professor Robert Warington.

Schweizer, *Victor*. The distillation of resins. Resinate lakes and pigments. Carbon pigments and pigments for typewriting machines, manifolders, &c. pp. viii + 183. ill. London [1907]. (*Recd.* 16/5/7.)
From the Publishers: Messrs. Maclaren and Sons.

II. *By Purchase.*

Association des Chimistes de Sucrerie et de Distillerie de France et des Colonies. Bulletin. Vol. XXIV, &c. Paris 1907 +. (*Reference.*)

Bollettino Chimico Farmaceutico. Edited by *Arturo* **Castoldi** [and others]. Milano 1907 +. (*Reference.*)

Chemisch Weekblad. Edited by *D. B.* **Centen.** Year IV, &c. Amsterdam 1907 +. (*Reference.*)

Deutsche botanische Gesellschaft. Berichte. Vol. XXV, &c. Berlin 1907 +. (*Reference.*)

Deutsche pharmaceutische Gesellschaft. Berichte. Year XVII, &c. Berlin 1907 +. (*Reference.*)

Deutsche physikalische Gesellschaft. Berichte. Edited by *Karl* **Scheel.** Year V, &c. Braunschweig 1907. (*Reference.*)

Gesellschaft Deutscher Naturforscher und Ärzte. Verhandlungen. 78, 1906, &c. Leipzig 1907 +. (*Reference.*)

Ladenburg, *A.* Vorträge über die Entwicklungsgeschichte der Chemie von Lavoisier bis zur Gegenwart. 4 Auflage. pp. xiv + 417. Braunschweig 1907. (*Recd.* 17/5/7.)

Lusk, *Graham.* The elements of the science of nutrition. pp. 326. Philadelphia 1906. (*Recd.* 18/5/7.)

Pharmaceutisch Weekblad voor Nederland. Edited by *D. B.* **Centen.** Year XLIV, &c. Amsterdam 1907 +. (*Reference.*)

Pharmaceutische Centralhalle für Deutschland. Edited by *A.* **Schneider** and *P.* **Süss.** Year XLVIII, &c. Dresden 1907 +. (*Reference.*)

Pharmazeutische Zeitung. Edited by *H.* **Böttger.** Year LII, &c. Berlin 1907 +. (*Reference.*)

Physikalische Zeitschrift. Edited by *E.* **Riecke** and *H. Th.* **Simon.** Year VIII, &c. Leipzig 1907 +. (*Reference.*)

Röttger, *H.* Lehrbuch der Nahrungsmittel-Chemie. 3 Auflage. pp. xiv + 901. ill. Leipzig 1907. (*Recd.* 31/5/7.)

Stewart, *A. W.* Stereochemistry. pp. xx + 583. ill. London 1907. (*Recd.* 1/6/7.)

At the next Ordinary Meeting, on **Thursday**, June **20th**, **1907**, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :

"Some properties of radium emanation." By A. T. Cameron and Sir W. Ramsay.

"The affinity constants of aminosulphonic acids as determined by the aid of methyl-orange." By V. H. Veley.

"Azo-derivatives of 1 : 3-diphenylbarbituric acid. Dynamic isomerism among the coloured hydrazones of 1 : 3-diphenylalloxan." By M. A. Whiteley.

"A series of coloured diazo-salts derived from *p*-aminobenzo-α-naphthalide." By G. T. Morgan and W. O. Wootton.

"Colour and constitution of azo-compounds. Part I." By J. T. Hewitt and H. V. Mitchell.

"Colour and constitution of azo-compounds. Part II." By J. T. Hewitt and H. V. Mitchell.

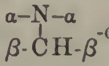
"The oxidation of hydrazines by free oxygen." By F. D. Chattaway.

"Calmatambin : a new glucoside." By F. L. Pyman.

"The decomposition of hyponitrous acid in presence of mineral acids." By P. C. Rây and A. C. Ganguli.

"The chemical composition of petroleum from Borneo." By H. O. Jones and H. A. Wootton.

"The synthesis of phenonaphthacridines. Trimethylphenonaphthacridines." By A. Senier and P. C. Austin.

"The condensation of aldehydes with mixtures of α-naphthol and α-naphthylamine : synthesis of 7-aryl  $\overset{\alpha-\text{N}-\alpha}{\beta\text{-CH-}\beta}$-dinaphthacridines." By A. Senier and P. C. Austin.

"An improved form of apparatus for the rapid estimation of sulphates and salts of barium." By W. R. Lang and T. B. Allen.

"The determination of sugar by Fehling's solution." By W. R. Lang and T. B. Allen.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, June 20th, 1907.

Colebourn, William Arthur,

34, Camp Street, Broughton, Manchester.

Assistant Technical Chemist. Was technically educated at the Royal Technical Institute, Salford, and the Municipal School of Technology, Manchester. Was a Crace Calvert Chemical Student at the Victoria University, Manchester. Have since been respectively engaged as assistant chemist to the Clayton Aniline Co., Ltd., Manchester, on aniline colour work; followed by designing experience with a Manchester firm of chemical and general engineers. Since May last have been engaged as second chemist to Messrs. Kodak, Ltd., Harrow, near London, photographic material manufacturers.

Harold B. Dixon. D. P. Hollingworth.
C. Sordes Ellis. L. G. Radcliffe.
John Allan. *S. J. Peachey.*

Copping, Hugh Hague,

Cabourne, Caistor, Lincolnshire.

Teacher of Science, King's Hospital, Dublin. B.A. Senior Moderator in Experimental Science, Trinity College, Dublin University.

Emil A. Werner. A. L. Robinson.
Sydney Young. Wm. Caldwell.
Wm. C. Ramsden.

Cornthwaite, Robert,

Agricultural Laboratory, Halifax.

Agricultural Analytical Chemist. Lecturer and Experimenter to the Potash Syndicate; Analytical Chemist to the West Riding Farmers' Association; Huddersfield Dairy Farmers' Supply Co., Ltd.; General Lecturer before the Farmers' Associations and Clubs on milk constituents, and also on agricultural chemistry, &c. Inventor of patent fat extractor for milk and food-stuffs analysis.

F. W. Brown.	R. O. Burland.
J. Stewart Remington.	*Wm. Percy Hatton.*
Alfred Sibson.	*Herbert Grime.*

Cowap, Matthewman Dalton,

21, Alma Square, St. John's Wood.

Experimental Chemist to Dr. Ludwig Mond, F.R.S., Assistant Analytical Chemist to Chemical Works.

Robert N. Lennox.	Bernhard Mohr.
John W. Heath.	*James D. Kettle.*

Alexander Scott.

Elias, Owen Aubrey.

123, Waller Road, New Cross, S.E.

Head of Scientific Dept., Chas. Zimmermann & Co., Manufacturing Chemists. Studied Chemistry at University Coll., N. Wales, and Physics at Mason's Coll., Birmingham, now Univ. Coll. Member Scientific Research Soc., Univ. Coll., Bangor. Inventor: Bimetric Minimeter and Automatic Pipette for separation of fluids of different specific gravity.

Hermann C. T. Gardner.	Robert Wm. Lindsey.
Frederic Jas. M. Page.	W. H. Martindale.

F. Filmer De Morgan.

Fischer, Eugen, Ph.D.

Biebrich, a/Rh., Germany.

Technical Director of the firm of Kalle & Co., Aktiengesellschaft, Biebrich, a/Rh.

C. Duisberg.	Thos. Tyrer.
B. E. R. Newlands.	*Arthur. J. Webb.*

Otto Hehner.

Gledhill, Walter George,

Dersingham, Greenroyde, Halifax.

Senior Science Master, Grammar School, Gt. Yarmouth. M.A. Camb. 2nd Class Honours, Natural Science Tripos. Teacher of Science since 1902. Past 3 years at Gt. Yarmouth. Maltster's Analyst.

James Sharp.	S. F. Dufton.
S. Ruhemann.	J. W. Pallister.

W. Cranfield.

Jennings, John Atkinson,

61, Gleneagle Road, Streatham, S.W.

Pharmaceutist to St. Thomas's Hospital, S.E. Pharmaceutical Chemist. Desirous of keeping in touch with current chemical literature.

Arthur W. Crossley.
Alfred E. Tanner.
H. R. Le Sueur.
Robert Wright.
P. Haas.
E. H. Farr.

Jensen, Charles William Lamb,

Oakhill, Nr. Bath.

Professional Brewer and Maltster, and Scientific Adviser to the Oakhill Brewery Co. Have written a treatise on brewing and malting and taught these to numbers of pupils with chemistry and biology as applied to those industries. My reason for joining the Chemical Society is that I may still further increase my knowledge of chemistry and biology.

J. M. Collett.
A. E. Beanes.
H. J. Wiffen.
Thos. D. Lichtenstein.
G. F. Kendall.

Lloyd, Percival George,

15, Woodside Road, Kingston-on-Thames.

Chemist and Assistant Manager, Native Guano Co.'s Kingston Works, Pupil of the late Prof. Wanklyn, Analyst at Kingston Sewage Works. Eighteen years' experience in the Chemical and Bacterial treatment and utilisation of sewage.

Henry Kenwood.
Edward C. Seaton.
W. J. Dibdin.
David Sommerville.
Colin C. Frye.
H. H. Slater.
F. Wallis Stoddart.

Nuttall, Walter Harold,

55, Market Street, Watford, Herts.

Research Chemist. Am a Fellow of the Institute of Chemistry, and hold their special Diploma in Therapeutics, Pharmacology, Microscopy. Four years' study at the University College, Nottingham, under Prof. Kipping. One year's study at Berne University (Switzerland) under Prof. Kostanecki. Three years Head Assistant to the Nottingham City Analyst. For last 18 months, Chief Chemical Assistant at the "Cooper Research Laboratory," Watford.

F. Stanley Kipping.
J. J. Sudborough.
H. J. H. Fenton.
G. Druce Lander.
W. F. Cooper.

Pochin, Harold,

12, Chapel Street, Berkhamsted, Herts.

Assistant Schoolmaster. Graduate in Science (Honours), Cambridge University. Science Master at Berkhamsted School. I am desirous of keeping in touch with modern chemical science.

J. H. Robbins.
H. W. Davis.
C. Proctor.
J. Woodward.
E. Grant Hooper.

Tinkler, Charles Kenneth,

297, Franklin Road, King's Norton, Nr. Birmingham.

Lecturer and Demonstrator in Chemistry, The University, Birmingham. B.Sc. (Wales), 1st class honours in Chemistry.

Percy F. Frankland.
James J. Dobbie.
Alexander Lauder.
Alex. Findlay.
Hamilton McCombie.

Warner, Charles Horne,

24, Gordon Street, Gordon Square, W.C.

Demonstrator in Chemistry at the School of the Pharmaceutical Society. Pharmaceutical Chemist.

Arthur W. Crossley.
T. E. Wallis.
Herbert Jackson.
E. Towyn Jones.
J. E. Coates.

Young, Walter Ormston,

Springfield, Cartmel, Lancs.

Analyst. Ten years Assistant Chemist to Sir W. G. Armstrong, Whitworth & Co., Ltd. Two years First Assistant to J. Stewart Remington, Esq., Aynsome, Lancs.

J. Stewart Remington.
Claude Smith.
John Hamer.
Cecil Cooke Duncan.
R. R. Tatlock.

Zortman, Israel Hyman,

Sternwartenstr. 44 IIr, Leipzig.

Research Student. B.Sc. (Vict.). Joint paper with Prof. J. B. Cohen entitled "The Rotation of the Menthyl Esters of the Isomeric Dibromobenzoic Acids," *Trans. Chem. Soc.*, 1906. "1851 Exhibition" Scholar (Leeds University). Engaged in research work with Prof. Hantzsch, Leipzig.

Arthur Smithells.
J. B. Cohen.
H. M. Dawson.
W. Lowson.
C. E. Whiteley.

The following certificate has been authorised for presentation to Ballot by the Council, under Bye-law I (3).

Sahni, Ruchi Ram,
Lahore, India.

Assistant Professor of Chemistry, Government College, Lahore. M.A. in Physics and Chemistry, 1885. Assistant Professor of Chemistry, Government College, Lahore. Member of the Syndicate and Science Faculty of the Punjab University.

P. C. Rây. B. Mouat Jones.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/6/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 328.

Thursday, June 20th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. :

Arthur John Banks, 61, Lawton Road, Waterloo, Liverpool.
John Kaye, M.A., B.Sc., Westerfield, Perth.
Marcus Wechsler, D.Sc., 136, Sinclair Road, Kensington, W.

Certificates have been authorised by the Council under Bye-Law I. (par. 3) in favour of Messrs. :

David Leo Behrmann, 75, Sirewright Avenue, Doomfontein, Transvaal.
William Bush Schober, B.Sc., Ph.D., Lehigh Univ., South Bethlehem, U.S.A.

A Ballot for the Election of Fellows was held, and the following were subsequently declared duly elected :

William Arthur Colebourn.
Hugh Hague Copping, B.A.
Matthewman Dalton Cowap.
Owen Aubrey Elias.
Eugen Fischer, Ph.D.
Walter George Gledhill, M.A.
John Atkinson Jennings.
Charles William Lamb Jensen.
Percival George Lloyd.
Walter Harold Nuttall.
Harold Pochin, B.A.
Ruchi Ram Sahni, M.A.
Charles Kenneth Tinkler, B.Sc.
Charles Horne Warner.
Walter Ormston Young.
Israel Hyman Zortman, B.Sc.

Of the following papers, those marked * were read :

*134. "Some properties of radium emanation." By Alexander Thomas Cameron and Sir William Ramsay, K.C.B.

It has been discovered that the emanation from radium undergoes a rapid change of volume shortly after its change from the solid to the gaseous state ; this is followed by a slow change, corresponding with its loss of electrical activity. Glass tubes, as well as silica tubes, were used for the experiments. The absorption of helium, hydrogen, oxygen, and carbon dioxide was investigated in these tubes so as to estimate the necessary corrections for the loss of volume by the emanation. It has been shown by thirty sets of measurements that the emanation behaves in accordance with Boyle's law, both before and after this preliminary change. Measurements have been made of the initial volume of the emanation, obtained from a solution of 87·7 milligrams of radium (metal) as bromide and sulphate. From these it would appear that, instead of the previously accepted value for the average-life-period of radium, 1100 years, a much shorter life must be deduced, namely, 236 years. The change of fresh emanation is accompanied by a halving of its volume, and reasons were adduced for the belief that this change corresponds with its polymerisation from Em^1 into Em^2 ; the change, as shown by time measurements, is a unimolecular reaction, and the subsequent rate of contraction agrees numerically with the loss of electrical activity. It has also been shown that helium, contained in silica vessels, may pass into the walls, but the conditions under which this absorption takes place have not been elucidated. Lastly, a deposit consisting doubtless of radium *D* has been observed ; it is a brown substance, with a sub-metallic lustre, not easily attacked by oxygen. The half-life-period of radium *D* is said to be forty years, whilst those of radium *A*, *B*, and *C* are only a few hours.

DISCUSSION.

Professor CLOWES asked whether statements made by Dr. Thorpe that afternoon, which were supplementary to his Bakerian lecture, might not explain the presence of free hydrogen after exploding the mixture of oxygen and hydrogen arising from the decomposition of water. The lecturer had mentioned that he had invariably noticed an odour of ozone and of hypochlorite from solutions of radium bromide. If ozone were formed, this would lead to removal of oxygen by the action of the mercury in the pump, and if hypochlorite were produced, oxygen would remain combined in the solution. An excess of hydrogen would in either case remain after the explosion.

Mr. BALY asked whether it were not possible that the discrepancy between Sir William Ramsay's and Prof. Rutherford's values for the life of the radium atom could be explained by the life being shortened in the presence of the emanation. It was necessary to assume that the radium atom was in a very unstable condition and it appeared possible that its disintegration might be assisted by the bombardment due to the decomposition of the emanation. Prof. Rutherford made his observations with a very thin layer of radium bromide on a plate from which the emanation readily escaped. Sir William Ramsay on the other hand allowed the solution of radium bromide to stand for periods of four days during which time the emanation was concentrating in the solution.

In reply to a question from Prof. Rutherford, Sir W. RAMSAY stated that the emanation, when it passes from the solid to the gaseous state, passes at once into a monatomic gas, although one would imagine that a diatomic gas would be preferably formed. This may conceivably be connected with another unusual phenomenon which it displays; for at 80° the diatomic gas reverts almost entirely to its monatomic state, at 132° the reversion is not so complete, and at 237° still less complete. This is contrary to the general behaviour of compounds, yet it is not inconceivable that a higher temperature might prove favourable to combination and that a diatomic gas may be more stable at high than at low temperatures. The author, however, maintained that he was there to chronicle and not to defend the behaviour of the emanation.

The volume of helium produced from 1 volume of an emanation is about 3½ volumes—agreeing in this respect with Prof. Rutherford's contention that the α-particle is a helium atom. In reply to Prof. Clowes, it was pointed out that no ozone is produced from a solution of radium bromide although the solid bromide has an odour of ozone.

*135. "The affinity constants of aminosulphonic acids as determined by the aid of methyl-orange." By Victor Herbert Veley.

In continuation of a former investigation on this subject (*Trans.*, 1907, 91, 153) the affinity constants of certain aminonaphtholsulphonic acids have been determined, and the general results are as follows.

(i) The affinity constants of the aminonaphtholsulphonic acids when determined by the tintometer method show, as regards the effect of the introduction of the hydroxyl grouping in the naphthylaminesulphonic acids, relationships similar to those observed by Ostwald by the electric conductivity method for the hydroxybenzoic acids as compared with benzoic acid.

(ii) One possible case of steric hindrance induced by the introduction of the hydroxyl grouping in the 8-position was noted.

Attempts were made to examine the naphtholsulphonic acids by the above method, but the acidic reaction appeared to be mollified by some subsequent secondary change.

*136. "Azo-derivatives of 1:3-diphenylbarbituric acid. Dynamic isomerism among the coloured hydrazones of 1:3-diphenylalloxan." By Martha Annie Whiteley.

In order to thrown some light on the structure of the compounds obtained by the action of aromatic diazonium chlorides on the 5-alkyl-substituted derivatives of 1:3-diphenylbarbituric acid (*Proc.*, 1906, 22, 201), the investigation has been extended, and the action of the β-substituted derivatives of phenylhydrazine on 5:5-dibromo-1:3-diphenylbarbituric acid has been examined. The results show that the compounds obtained in the first reaction are *azo*-derivatives, whilst those obtained in the second are *hydrazones*.

In the course of the investigation the following compounds have been prepared: *5-benzeneazo-5-benzyl-*1 : 3*-diphenylbarbituric acid*, $\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C}{<}\substack{\mathrm{CH_2Ph}\\ \mathrm{N{:}NPh}}$; *5-benzeneazo-5-diphenylmethyl-*1 : 3*-diphenylbarbituric acid*, $\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C}{<}\substack{\mathrm{CHPh_2}\\ \mathrm{N{:}NPh}}$; the *nitro*-derivative, $\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C}{<}\substack{\mathrm{CHPh_2}\\ \mathrm{N{:}N\cdot C_6N_4\cdot NO_2}}$, melt and decompose at 170—171°, 160°, and 175° respectively. These compounds are yellow. 1 : 3-*Diphenylalloxanphenylmethylhydrazone*,

$$\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C{:}N\cdot NPhMe};$$

1 : 3-*diphenylalloxandiphenylhydrazone*, $\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C{:}N\cdot NPh_2}$;

1 : 3-*diphenylalloxanphenylbenzylhydrazone*,

$$\mathrm{CO}{<}\substack{\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}}{>}\mathrm{C{:}N\cdot NPh(CH_2Ph)},$$

melt and decompose at 175°, 254—255°, and 130—131° respectively; these compounds exist in two forms, one yellow and one red.

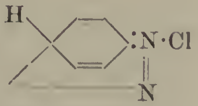
*137. "A series of coloured diazo-salts derived from benzoyl-1:4-naphthylenediamine." By Gilbert Thomas Morgan and William Ord Wootton.

The examination of the diazo-salts of benzoyl-*p*-phenylenediamine and benzoyl-1 : 4-naphthylenediamine has been continued and it has been found that the diazo-derivatives of the latter base are extremely stable substances which are invariably coloured.

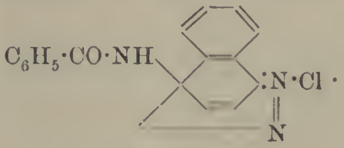
Benzoyl-4-aminonaphthalene-1-diazonium chloride,
$C_6H_5{\cdot}CO{\cdot}NH{\cdot}C_{10}H_6{\cdot}N_2{\cdot}Cl$,
m. p. 140° with decomposition, crystallises in well-defined, yellow needles which retain their colour after repeated crystallisation from water or fractional precipitation from different organic media. The corresponding *bromide, iodide, sulphate, nitrate, nitrite, chlorate, perchlorate, carbonate, trichloroacetate*, and *thiocyanate* have been prepared. The sulphate crystallises in golden-yellow leaflets or needles, whilst the perchlorate, which is quite stable in the dry state, separates in sparingly soluble, light yellow crystals and is the palest compound of the series. These compounds have the chemical properties of diazonium salts and couple readily with alkaline β-naphthol to furnish azo-derivatives. With potassium cyanide they yield *benzoyl-4-aminonaphthalene-1-diazocyanide*, a stable, red microcrystalline compound which does not couple with alkaline β-naphthol.

These coloured salts might be regarded either as *syn*-diazo-derivatives or as equilibrium mixtures of diazonium and *syn*-diazo-derivatives, although their great stability somewhat militates against the assumption that they consist wholly or in part of *syn*-diazo-compounds. The existence of such a series of coloured diazo-salts would be anticipated from the formulation recently suggested by Cain for diazonium salts (formula I)

(I).



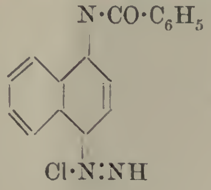
(II).



According to this view, the appearance of colour in the foregoing series may be connected with the replacement of a benzene by a naphthalene nucleus and the substitution of the hydrogen atom of formula (I) by the heavy group $C_6H_5{\cdot}CO{\cdot}NH$ of formula (II).

Discussion.

Dr. Hewitt thought it very probable that coloured diazonium salts might possess a quinonoid structure. But as in all cases when the salts were coloured they allowed of a true quinonoid formulation, Dr. Morgan's compound might well have the constitution



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whilst the constitution Dr. Morgan assigned to the salt more resembled that of the "chinols" of Bamberger, which are colourless.

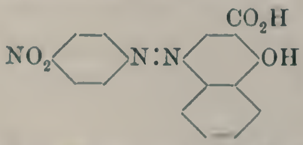
Dr. CAIN thought there was much danger in speculating as to the colour of a compound entirely from the quinonoid or non-quinonoid state of only a part of the molecule. The rest of the molecule, as Dr. Morgan had pointed out, was of much importance in attempting to arrive at an explanation of the colour.

In reply, Dr. MORGAN said that he preferred the formula for diazo-salts advocated by Dr. Cain to those which required the presence of a labile hydrogen atom in the para-position to the diazonium complex because the former configuration was applicable both to the simpler colourless diazonium salts and also to the more complex coloured diazo-derivatives described in this communication. The development of colour in this series of substances seemed to depend to some extent on the nature of the aromatic nucleus and partly on the presence of a complex substituent in the para-position to the diazo-nitrogen. Further experimental evidence, however, would be required before the conditions determining the appearance of colour among the diazonium derivatives could be completely defined.

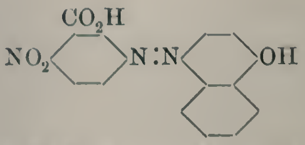
*138. "Colour and constitution of azo-compounds. Part I." By John Theodore Hewitt and Herbert Victor Mitchell.

The authors recently drew attention to the very marked change in colour when *p*-nitro-derivatives of arylazo-*p*-phenols were dissolved in alkalis (*Trans.*, 1906, **89**, 13, 17). The explanation was offered that whilst benzēneazophenol forms alkaline salts of corresponding constitution, the *p*-nitro-derivatives furnish salts with the metal attached to the nitro-group and therefore diquinonoid in structure. The relationships are rendered apparent by the formulæ $C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}OK$ and $KO_2N{:}C_6H_4{:}N{\cdot}N{:}C_6H_4{:}O$.

Definite proof has been obtained of the correctness of this view by a comparison of the two carboxylic acids derived from *p*-nitrobenzene-azo-*α*-naphthol of the formulæ



and



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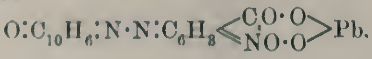
Both these compounds give deep blue, alkaline solutions, but, whilst the former yields brown precipitates with salts of heavy metals, the latter gives blue precipitates; no doubt in the latter case the lead salt has the constitution



$$O{:}C_{10}H_6{:}N{\cdot}N{:}C_6H_3<\begin{matrix}CO{\cdot}O\\NO{\cdot}O\end{matrix}>Pb.$$

The following compounds were described :

2-*Nitro-5-acetylaminobenzoic acid*, m. p. 210—220° (with decomposition). 2-*Nitro-5-aminobenzoic acid*, m. p. about 235°. p-*Nitro*-m-*carboxybenzeneazo-α-naphthol*, m. p. 260°. o-*Nitrobenzeneazo-α-hydroxy-β-naphthoic acid*, m. p. 200°. m-*Nitrobenzeneazo-α-hydroxy-β-naphthoic acid*, m. p. 220—225°. p-*Nitrobenzeneazo-α-hydroxy-β-naphthoic acid*, m. p. 242°. p-*Nitro*-m-*carboxybenzeneazophenol*, m. p. 195°. p-*Nitro*-m-*carboxybenzeneazo*-o-*nitrophenol*, m. p. 213°. p-*Nitro*-o-o-*dibromophenol*, m. p. 205—206°. p-*Nitrobenzeneazosalicylaldehyde*, m. p. 192—193°; its *acetyl* derivative, m. p. 150°, and *phenylhydrazone*, m. p. 235—240°. The melting points in this and the preceding papers are uncorrected, the decomposition which occurs rendering accurate observation impossible.

The general result arrived at is that the frequency of the absorbed light is lowered by increase in the length of the chain of alternate single and double linkings. The introduction of substituents may modify the length of the chain owing to the possibility of more stable salt formation in other directions.

139. "The oxidation of hydrazines by free oxygen."

By Frederick Daniel Chattaway.

Hydrazines of the formula $R{\cdot}NH{\cdot}NH_2$, where R is a cyclic group, are readily oxidised by free oxygen, the action being accelerated in a remarkable way by alkali hydroxides. In the case of phenylhydrazine dissolved in about three times its weight of 4*N*-alcoholic potash, oxidation is so rapid that the liquid effervesces freely from escape of nitrogen on mere exposure to the air.

The action appears to be a general one, and results in the liberation of nitrogen and the replacement of the $NH{\cdot}NH_2$ group by hydrogen, thus: $R{\cdot}NH{\cdot}NH_2 + O = R{\cdot}H + N_2 + H_2O$.

It is simply explained by assuming that when such a hydrazine is oxidised, an unstable hydroxyhydrazine is first produced, which at once decomposes, thus: $R{\cdot}HN{\cdot}NH_2 \longrightarrow R{\cdot}HN{\cdot}NH{\cdot}OH \longrightarrow RH + N_2 + H_2O$.

The action which takes place in the oxidation of hydrazines is thus closely connected with those reactions of diazonium compounds in which the diazonium group is replaced by hydrogen.

140. "Calmatambin: a new glucoside." By Frank Lee Pyman.

The author described the isolation of a new glucoside, *Calmatambin*, from the bark of a tree indigenous to West Africa, which is known to the natives as *Calmatamba*, and is probably identical with *Canthium glabrifolium*.

The glucoside has the formula $C_{19}H_{28}O_{13},2H_2O$, and crystallises in needles melting at 100°. The anhydrous substance melts at 144—145°. It contains one methoxyl group, has $[\alpha]_D$ $-130{\cdot}4°$, and occurs in the bark to the amount of 1·1 per cent. It is readily hydrolysed by dilute acids and by emulsin.

Octa-acetyl-calmatambin, $C_{19}H_{20}O_{13}(C_2H_3O)_8$, forms needles melting at 179—180°, and has $[\alpha]_D$ $-107{\cdot}1°$.

Calmatambetin, $C_{13}H_{18}O_8,\frac{1}{2}H_2O$, is formed together with dextrose by the action of emulsin on calmatambin according to the equation $C_{19}H_{28}O_{13} + H_2O = C_6H_{12}O_6 + C_{13}H_{18}O_8$. It crystallises in needles melting at 148—149°. It contains one methoxyl group and is optically inactive. It is readily decomposed by the action of dilute acids, and yields a small amount of a scarlet, crystalline *substance*, $C_{11}H_{12}O_3$, melting at 91°, which is volatile with steam, and has an aromatic odour; it may very possibly be a quinone.

The foregoing results show that calmatambin is a β-glucoside, having the constitution represented by the formula

$$CH_3{\cdot}O{\cdot}C_{12}H_{10}O_2(OH)_4{\cdot}O{\cdot}C_6H_{11}O_5.$$

Calmatambin is devoid of any appreciable physiological action.

141. "The decomposition of hyponitrous acid in presence of mineral acids." By Prafulla Chandra Rây and Atul Chandra Gañguli.

Hyponitrous acid, when liberated from silver or mercurous hyponitrite by the action of dilute nitric, hydrochloric, or sulphuric acid at 25° or a higher temperature, decomposes at once according to the following equations:

$$(1)\ 2HNO = H_2O + N_2O.$$
$$(2)\ 5HNO = 2H_2O + HNO_3 + 4N.$$

Neither nitrous acid, ammonia, or hydroxylamine is formed. The presence of the mineral acids has a specific directive influence in determining the course of reaction.

142. "The chemical composition of petroleum from Borneo." By Humphrey Owen Jones and Hubert Arthur Wootton.

The petroleum from Borneo has been found to consist of approximately equal quantities of homologous hydrocarbons of the paraffin, *cyclo*hexane, and aromatic series, and to contain the members of the naphthalene series to the extent of about 6—7 per cent. The less volatile portions of the oil are optically active.

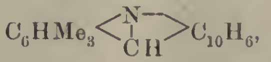
It forms a very convenient source of the nitro- and amino-derivatives of the aromatic hydrocarbons, which may be obtained in large quantities and in a highly pure state.

143. "The synthesis of phenonaphthacridines: trimethylphenonaphthacridines." By Alfred Senier and Percy Corlett Austin.

The authors have employed the methylene di-iodide and arylamine method (Senier and Goodwin, *Trans.*, 1902, **81**, 280) for the synthesis of phenonaphthacridines by using equimolecular mixtures of ψ-cumidine and naphthols, and good yields of the two desired trimethylphenonaphthacridines were obtained. When the naphthylamines were used in place of the naphthols, the product generally contained the corresponding dinaphthacridine.

The condensation of trioxymethylene with ψ-cumidine and the naphthols effected the synthesis of the same two compounds, but in this case the yields were smaller and the products less easily purified.

8 : 9 : 11-*Trimethylpheno*-$\begin{smallmatrix}\mathrm{N}-\alpha\\ |\\ \mathrm{CH}\text{-}\beta\end{smallmatrix}$-*naphthacridine*,



$$C_6HMe_3{<}\begin{smallmatrix}\mathrm{N}-\\ |\\ \mathrm{CH}\end{smallmatrix}{>}C_{10}H_6,$$

is obtained by condensation of methylene di-iodide with ψ-cumidine and α-naphthol. It crystallises from alcohol in greenish-yellow needles melting at 160° (162·5° corr.); its solutions are fluorescent.

The *platinichloride*, *aurichloride*, *mercurichloride*, *picrate*, and *bistrimethylphenonaphthacridine hexabromide* were described.

8 : 9 : 11-*Trimethylpheno*-$\begin{smallmatrix}\mathrm{N}-\beta\\ |\\ \mathrm{CH}\text{-}\alpha\end{smallmatrix}$-*naphthacridine*, isomeric with the above, was obtained in a similar manner, using β-naphthol instead of α-naphthol. It crystallises from alcohol in straw-coloured needles, melting at 136° (137° corr.), and its solutions are very faintly fluorescent.

The *hydriodide*, crystallising from aniline in orange needles, appeared as an intermediate product in the preparation of the base. The *platinichloride, aurichloride, and picrate* were also described.

144. "The condensation of aldehydes with mixtures of α-naphthol and α-naphthylamine: synthesis of 7-aryl-$\begin{smallmatrix}\alpha\text{-}\mathrm{N}-\alpha\\ |\\ \beta\text{-}\mathrm{CH}\text{-}\beta\end{smallmatrix}$-dinaphthacridines." By Alfred Senier and Percy Corlett Austin.

In continuation of the study of dinaphthacridines, the authors have found that certain general differences, which they ascribe to steric influence, dependent on the position of the angular rings (compare Hinsberg, *Ber.*, 1902, **36**, 4051) between the bases of the type $\begin{smallmatrix}\alpha-\mathrm{N}-\alpha\\ |\\ \beta\text{-}\mathrm{CH}\text{-}\beta\end{smallmatrix}$ and those of the type $\begin{smallmatrix}\beta\text{-}\mathrm{N}-\beta\\ |\\ \alpha-\mathrm{CH}\text{-}\alpha\end{smallmatrix}$ are well illustrated by a detailed investigation of the aldehyde, naphthol, and naphthylamine method of synthesis, first introduced by Ullmann and Fetvadjian (*Ber.*, 1903, **36**, 1027).

Trioxymethylene does not yield the $\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-dinaphthacridine, whereas it readily forms the $\begin{matrix}\beta\text{-N—}\beta\\ |\\ \alpha\text{-CH-}\alpha\end{matrix}$-isomeride; benzaldehyde gives the 7-phenyl derivative of both types, and from *m*-nitrobenzaldehyde was obtained 7-*m*-nitrophenyl-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-dinaphthacridine, whereas Haase (*Ber.*, 1903, **36**, 593) found that with β-naphthol and β-naphthylamine it gave a dihydro-derivative of the corresponding dinaphthacridine, which could not be oxidised to the base.

From anisaldehyde and the three tolualdehydes, only derivatives of the $\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-type could be obtained. It was also noticed that in the preparation of dinaphthacridines of this type, hydro-derivatives were never formed.

7-o-*Tolyl*-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-*dinaphthacridine* is obtained in yellow crystals melting at 212° (215° corr.), and forms a *platinichloride*, *aurichloride*, and *picrate*.

7-m-*Tolyl*-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-*dinaphthacridine* is a yellow, crystalline powder melting at 251° (257° corr.), and gives a *platinichloride*, *aurichloride* and *picrate*.

7-p-*Tolyl*-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-*dinaphthacridine* forms pale greenish-yellow, rhombohedral crystals melting at 221° (224° corr.), and gives a *platinichloride*, *aurichloride*, and *picrate*.

7-p-*Methoxyphenyl*-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-*dinaphthacridine* crystallises from benzene in small, yellow rhombohedra melting at 257° (263° corr.), and forms a *platinichloride*, *aurichloride*, and *picrate*.

7-m-*Nitrophenyl*-$\begin{matrix}\alpha\text{-N—}\alpha\\ |\\ \beta\text{-CH-}\beta\end{matrix}$-*dinaphthacridine* crystallises from benzene in small, yellow crystals which did not melt below 300°; no sign of fluorescence was observed in any of its solutions. The *platinichloride*, *aurichloride*, and *picrate* were prepared.

145. "An improved form of apparatus for the rapid estimation of sulphates and salts of barium." By William Robert Lang and Thomas B. Allen.

N. Tarugi and G. Bianchi (*Gazzetta*, 1906, **36**, i, 347) have described an apparatus for the rapid estimation of sulphates and salts of barium by a volumetric method based on the rapid clearing of turbid solutions in tubes of narrow calibre. Their apparatus is somewhat complicated, and the authors have simplified it materially. The solution containing the precipitated barium sulphate is forced, by air pressure applied by hand, up a narrow tube, allowed to clear—which it does rapidly as the end-point of the reaction is approached—and a drop of the precipitant added. Any milkiness is plainly observed in the narrow tube, and the solution is washed down into the flask and fresh portions forced up the tube from time to time until further addition of the reagent causes no change. Experiments were made with solutions of sulphuric acid of various concentrations, with the sulphates of copper and of nickel, and also with iron pyrites to determine its sulphur content. The errors, as compared with the gravimetric estimation of sulphur as barium sulphate, range from 1 to 0·1 per cent., but such errors are materially reduced by taking the average of five or six titrations, and the whole operation can be completed in less than an hour.

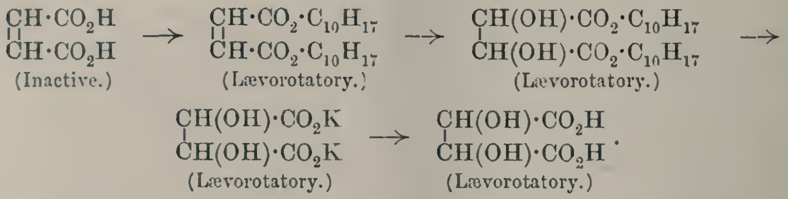
146. "The determination of sugar by Fehling's solution." By William Robert Lang and Thomas B. Allen.

The apparatus described by the authors (preceding paper) for the estimation of sulphuric acid and sulphates, based on the principle of the rapid clearing of turbid solutions in tubes of narrow calibre, was employed for the determination of dextrose by means of Fehling's solution. Accurate results were obtained when the solution was heated to its boiling point, the concentration being not more than 0·15 gram in 75—100 c.c. of water, and the time of heating being five minutes. Under these conditions the average error varied from 0·1 to 0·30 per cent., but when the solutions were greatly diluted or the time of heating extended from ten to twenty minutes the results varied more than 1 per cent.

147. "Studies in asymmetric synthesis. VI. The asymmetric synthesis of the optically active tartaric acids." By Alexander McKenzie and Henry Wren.

The asymmetric synthesis of *l*-tartaric acid was accomplished in three ways.

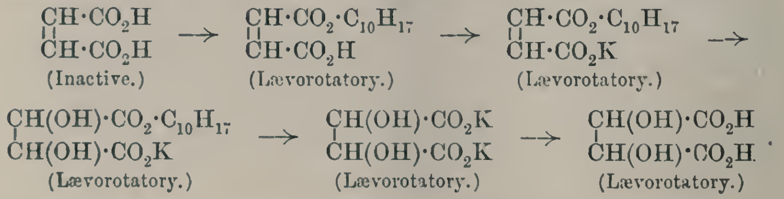
(1) By the oxidation of *l*-bornyl fumarate in glacial acetic acid solution by potassium permanganate, according to the scheme:



$$\begin{array}{c}\mathrm{CH\cdot CO_2H}\\ \|\\ \mathrm{CH\cdot CO_2H}\\ \text{(Inactive.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \|\\ \mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2\cdot C_{10}H_{17}}\\ |\\ \mathrm{CH(OH)\cdot CO_2\cdot C_{10}H_{17}}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow$$

$$\begin{array}{c}\mathrm{CH(OH)\cdot CO_2K}\\ |\\ \mathrm{CH(OH)\cdot CO_2K}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2H}\\ |\\ \mathrm{CH(OH)\cdot CO_2H}\\ \text{(Lævorotatory.)}\end{array}.$$

(2) By the oxidation of the potassium salt of *l*-bornyl hydrogen fumarate in aqueous solution by potassium permanganate, thus:



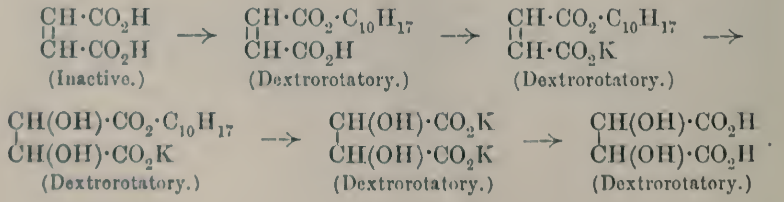
$$\begin{array}{c}\mathrm{CH\cdot CO_2H}\\ \|\\ \mathrm{CH\cdot CO_2H}\\ \text{(Inactive.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \|\\ \mathrm{CH\cdot CO_2H}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \|\\ \mathrm{CH\cdot CO_2K}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow$$

$$\begin{array}{c}\mathrm{CH(OH)\cdot CO_2\cdot C_{10}H_{17}}\\ |\\ \mathrm{CH(OH)\cdot CO_2K}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2K}\\ |\\ \mathrm{CH(OH)\cdot CO_2K}\\ \text{(Lævorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2H}\\ |\\ \mathrm{CH(OH)\cdot CO_2H}\\ \text{(Lævorotatory.)}\end{array}.$$

In these two cases the change $\begin{array}{c}\mathrm{CH\cdot CO_2H}\\ \|\\ \mathrm{CH\cdot CO_2H}\end{array}$ (inactive) $\longrightarrow$ $\begin{array}{c}\mathrm{CH(OH)\cdot CO_2H}\\ |\\ \mathrm{CH(OH)\cdot CO_2H}\end{array}$ (active) is rendered possible by the introduction and subsequent complete elimination of the *l*-bornyl group.

(3) By the oxidation of *l*-menthyl fumarate in an analogous manner.

The asymmetric synthesis of *d*-tartaric acid was accomplished by the oxidation of the potassium salt of *d*-bornyl hydrogen fumarate, thus:



$$\begin{array}{c}\mathrm{CH\cdot CO_2H}\\ \|\\ \mathrm{CH\cdot CO_2H}\\ \text{(Inactive.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \|\\ \mathrm{CH\cdot CO_2H}\\ \text{(Dextrorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH\cdot CO_2\cdot C_{10}H_{17}}\\ \|\\ \mathrm{CH\cdot CO_2K}\\ \text{(Dextrorotatory.)}\end{array} \longrightarrow$$

$$\begin{array}{c}\mathrm{CH(OH)\cdot CO_2\cdot C_{10}H_{17}}\\ |\\ \mathrm{CH(OH)\cdot CO_2K}\\ \text{(Dextrorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2K}\\ |\\ \mathrm{CH(OH)\cdot CO_2K}\\ \text{(Dextrorotatory.)}\end{array} \longrightarrow \begin{array}{c}\mathrm{CH(OH)\cdot CO_2H}\\ |\\ \mathrm{CH(OH)\cdot CO_2H}\\ \text{(Dextrorotatory.)}\end{array}.$$

148. "Some derivatives of 2-phenyl-1:3-naphthylenediamine. Part I." By Norman Lees and Jocelyn Field Thorpe.

The β-amino-group in 2-phenyl-1:3-naphthylenediamine is more strongly basic than the amino-group in the α-position, and is the one first acted on in salt formation, diazotisation, and acetylation, Derivatives of the base, in the formation of which the β-amino-group takes part, can therefore be prepared directly from the base itself, whereas, since the β-amino-group can be readily protected by acetylation, those compounds which are derived from the amino-group in the α-position can be prepared from the monoacetyl derivative of the base.

2-Phenyl-1:3-naphthylenediamine combines with diazonium salts, forming azo-compounds, the azo-group entering in the position 4 in the naphthalene ring. The colours of these compounds do not differ appreciably in shade from those of the corresponding compounds derived from 1:3-naphthylenediamine; hence the presence of the phenyl group has little or no effect on the colour of compounds of this type.

Typical derivatives of the base have been prepared and investigated. The conditions have also been determined under which it is converted into the corresponding dinaphthol and the two aminonaphthols.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Chemical Trade Journal. Edited by *George E.* **Davis.** Vols. I to XI. Manchester 1887–1892. (*Recd.* 14/6/7.)

From Dr. C. E. Fawsitt.

Chemiker Zeitung. Edited by *G.* **Krause.** Year VI. Cöthen 1882. (*Recd.* 10/6/7.) From A. Esilman, Esq.

Herrick, *Rufus Frost.* Denatured or industrial alcohol. A treatise on the history, manufacture, composition, uses, and possibilities of industrial alcohol in the various countries permitting its use, and the laws and regulations governing the same. pp. x+516. ill. New York 1907. (*Recd.* 19/6/7.)

From the Publishers: Messrs. John Wiley and Sons.

Jahrbuch der Chemie. Edited by *Richard* **Meyer.** Year I. 1891. Frankfurt 1892. (*Recd.* 5/6/7.) From J. Tudor Cundall, Esq.

Journal für praktische Chemie. Edited by *Hermann* **Kolbe** and *Ernst von* **Meyer.** New series. Vols. XXIII to XXVIII. Leipzig 1881—1883. (*Recd.* 12/6/7.)

From Geh. Rath Professor Dr. Liebermann.

THE LIBRARY.

The Library will be closed throughout the month of August, when the Society's Rooms will be redecorated, and the annual revision of the volumes will take place.

Fellows are particularly requested to return all Library Books in their possession *not later than Wednesday, July* 31*st*

LIST OF FELLOWS, 1907.

The List of Fellows for 1907 is now in active preparation, and changes of address *received after* 31*st July cannot be included in it.*

In order that the new list may be as complete as possible, those Fellows whose degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

At the next Ordinary Meeting, on **Thursday**, July **4th**, 1907, at **8.30** p.m., the following papers will be communicated :

" *iso*Nitroso- and nitro-dimethyldihydroresorcin." By P. Haas.

" The structure of carbonium salts." By F. Baker.

"Studies of dynamic isomerism. Part VI. The influence of impurities on the mutarotation of nitrocamphor." By T. M. Lowry and E. H. Magson.

" The relation between absorption spectra and chemical constitution. Part VIII. The phenyl hydrazones and osazones of α-diketones." By E. C. C. Baly, W. B. Tuck, E. G. Marsden, and M. Gazdar.

" Permanganic acid." By M. M. P. Muir.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 13/7/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 329.

Thursday, July 4th, 1907, at 8.30 p.m., Sir Alexander Pedler, C.I.E., F.R.S., Vice-President, in the Chair.

Messrs M. D. Cowap, H. McCombie, O. A. Elias, and S. F. Stell were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

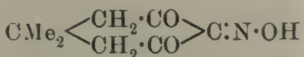
Benjamin Owen Jones, Boksburg, Transvaal.
Thomas Callan, B.Sc., 22, Church Street, Egremont, Cheshire.
Robert Harry Smith, Apsley House, Priory Road, Sheffield.

Of the following papers, those marked * were read:

*149. "*iso*Nitroso- and nitro-dimethyldihydroresorcin."

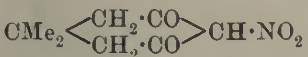
By Paul Haas.

When an ice-cold aqueous solution of the potassium salt of dimethyldihydroresorcin mixed with potassium nitrite is acidified, a pale yellow precipitate of iso*nitrosodimethyldihydroresorcin* (I):



$$CMe_2<\begin{matrix}CH_2\cdot CO\\CH_2\cdot CO\end{matrix}>C:N\cdot OH$$

(I.)



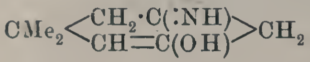
$$CMe_2<\begin{matrix}CH_2\cdot CO\\CH_2\cdot CO\end{matrix}>CH\cdot NO_2$$

(II.)

is obtained. That this substance is in reality an *iso*nitroso-derivative and not a nitroso-derivative is shown by the fact that it does not give

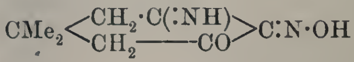
Liebermann's reaction, but on the contrary yields coloured *potassium*, *ammonium*, and *ferrous* salts after the manner of α-oximino-ketones. When *iso*nitrosodimethyldihydroresorcin suspended in ether is saturated with oxides of nitrogen, prepared from nitric acid and arsenious oxide, it is converted into *nitrodimethyldihydroresorcin* (II); this substance may also be prepared in a similar manner from dimethyldihydroresorcin itself.

The base (III), obtained by the action of ammonia on dimethyldihydroresorcin (*Trans.*, 1906, **89**, 191):



$$\mathrm{CMe_2}{<}\begin{matrix}\mathrm{CH_2\cdot C(:NH)}\\ \mathrm{CH{=}C(OH)}\end{matrix}{>}\mathrm{CH_2}$$

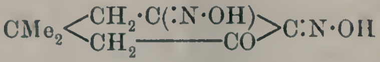
(III.)



$$\mathrm{CMe_2}{<}\begin{matrix}\mathrm{CH_2\cdot C(:NH)}\\ \mathrm{CH_2\text{———}CO}\end{matrix}{>}\mathrm{C{:}N\cdot OH}$$

(IV.)

when suspended in water and treated with nitrous acid at 0°, yields an iso*nitroso*-derivative of the formula (IV), which gives a crimson *potassium* salt and a blue *ferrous* salt. Both *iso*nitroso- (I) and nitrodimethyldihydroresorcin (II) on reduction yield an amine which is converted by nitrous acid into a substance of the formula $C_8H_{10}O_2N_2$. That nitrous acid in acting on the base (III) really attacks the carbon atom in the para-position relative to the two methyl groups, and not the imino-group, is shown by the fact that this *iso*nitroso-derivative (IV) yields on reduction and subsequent treatment with nitrous acid the same substance, $C_8H_{11}ON_8$, as is obtained by a similar series of reactions from the *mono-oxime* of *iso*nitrosodimethyldihydroresorcin (V):



$$\mathrm{CMe_2}{<}\begin{matrix}\mathrm{CH_2\cdot C(:N\cdot OH)}\\ \mathrm{CH_2\text{————}CO}\end{matrix}{>}\mathrm{C{:}N\cdot OH}$$

(V.)

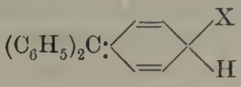
in which the nitrogen atoms are clearly attached to different carbon atoms.

*150. "The structure of carbonium salts." By Frank Baker.

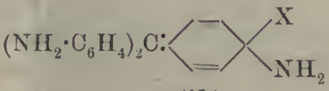
The author has examined the absorption spectra of the sulphates of several derivatives of benzylideneacetone, and also of triphenyl- and trianisyl-carbinol sulphates. These carbonium salts gave rise to two characteristic types of absorption.

p-Rosaniline base, as well as the mono-hydrochloride, shows the first type of curve, whilst in presence of more concentrated acid the second of these types of spectra is observed. From these results, the author concluded that the magentas are carbonium salts, similar to triphenylcarbinol sulphate.

Since Gomberg (*Ber.*, 1907, **40**, 1847) has shown that the latter compound possesses the structure (I):



(I.)



(II.)

the constitution (II) was ascribed by the author to the salts of *p*-rosaniline with one equivalent of acid.

The second of the above-mentioned types of curve is similar to those of the hydrochlorides of certain members of the hydroxyazo-group (Tuck, *Trans.*, 1907, **91**, 449), and the author suggested that these salts are also carbonium compounds.

The absorption spectrum of triphenylmethane was found to differ from that previously described by Hartley (*Trans.*, 1887, **51**, 152).

DISCUSSION.

Dr. CAIN mentioned that Gomberg himself, in the paper quoted by the author, adopted Nietzki's formula $(NH_2\cdot C_6H_4)_2C:<\!\!=\!\!>NH_2X$ for the salts of *p*-rosaniline. In view of the work of Hantzsch and Osswald and other chemists, which was generally considered to establish the correctness of Nietzki's formula, it was not likely that Mr. Baker's suggestion would be accepted by colour chemists, particularly as it seemed so improbable that the acidic group X should be attached to the carbon and not to the nitrogen atom.

Dr. HEWITT saw no necessity to ascribe a carbonium formula to the salts of hydroxyazo-compounds with mineral acids. Chemical reactions pointed to their substances having a quinonoid structure, but it was the phenolic nucleus which apparently becomes altered.

In reply, Mr. BAKER pointed out that Gomberg had suggested that in the formation of magenta from *p*-rosaniline base a carbinol corresponding to the salt of the structure shown by (II) was first formed, and that this compound passed into the iminoquinone, but no proof of the latter change had been presented.

*151. "Studies of dynamic isomerism. Part VI. The influence of impurities on the mutarotation of nitrocamphor." By Thomas Martin Lowry and Egbert Hochey Magson.

The velocity of mutarotation of nitrocamphor has been measured in a number of different solvents and in presence of a variety of added impurities.

In the experiments on glucose described in the first paper of this series (*Trans.*, 1903, **83**, 1314), it was found that the mutarotation in aqueous solutions could not be retarded by the addition of either acid or alkali, and appeared to be due to a direct interaction between the sugar and the solvent. In the case of nitrocamphor dissolved in chloroform, however, it has been found possible to retard the isomeric change by the addition of small quantities of acid, thus confirming the view already arrived at (*Trans.*, 1899, **75**, 221) that the mutarotation of the nitrocamphor in solvents such as chloroform and benzene is conditioned by the presence of alkaline impurities.

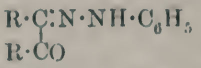
Sodium ethoxide added to an alcoholic solution of nitrocamphor was found to produce an acceleration very similar to that which results from the addition of potassium hydroxide to an aqueous solution of glucose. Extraordinary effects were produced, however, by the addition of piperidine to solutions of nitrocamphor in benzene or chloroform. In presence of $N/1000$ piperidine no mutarotation could be detected; with $N/10,000$ piperidine the mutarotation was complete in five minutes, with $N/100,000$ in an hour, and with $N/1,000,000$ in about ten hours; with $N/10,000,000$ piperidine the acceleration was of the same order of magnitude as that due to the trace of impurity normally present in the purified materials.

Discussion.

Mr. W. A. Davis, replying to the question raised by Dr. Lowry as to the origin of the peculiar odour noticed in the chloroform solutions used, suggested that it was due to carbonyl chloride formed by the action of the air on the chloroform. It would appear that this change was accelerated by the presence of an acid, in this case trichloroacetic acid; it was already well known that it could be prevented by having an alkali present such as lime.

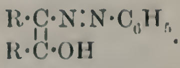
*152. "The relation between absorption spectra and chemical constitution. Part VIII. The phenylhydrazones and osazones of a diketones." By Edward Charles Cyril Baly, William Bradshaw Tuck, Effie Gwendoline Marsden, and [in part] Maud Gazdar.

From a consideration of their absorption spectra it was shown that the phenylhydrazones and osazones of the α-diketones in neutral solution possess the ketonic constitution, and that in alkaline solution the former tend to favour the enolic configuration, thus:



$$\begin{array}{l} R\cdot C{:}N\cdot NH\cdot C_6H_5 \\ \;\;\;| \\ R\cdot CO \end{array}$$

Neutral solution.



$$\begin{array}{l} R\cdot C\cdot N{:}N\cdot C_6H_5 \\ \;\;\;\| \\ R\cdot C\cdot OH \end{array}$$

Alkaline solution.

In the phenylhydrazones of hydroxy-ketones in which the hydroxyl group is adjacent to the $\colon C \colon N \cdot$ linking, direct evidence is found of the mutual influence of the hydroxyl group and the $C \colon N$ linking. This influence is best shown in the great retardation of the change of the hydrazone to the azo-form in light; moreover, it is this mutual influence which renders possible the oxidation of the hydroxyl group by excess of phenylhydrazine. Inasmuch as the change to the azo-form removes this influence upon the hydroxyl group, this change tends to restrain the oxidation of the hydroxyl group by phenylhydrazine, and as, further, acetic acid retards the change to the azo-form, so the presence of acetic acid aids the formation of the osazones with excess of phenylhydrazine.

153. "Permanganic acid." By Matthew Moncrieff Pattison Muir.

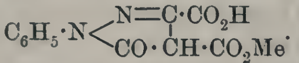
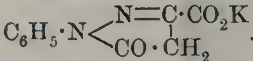
By adding the equivalent quantity of dilute sulphuric acid to a solution of barium permanganate, filtering through glass wool, and evaporating over sulphuric acid in a vacuum, solutions of permanganic acid, $HMnO_4$, containing about 17 per cent. of the acid, can be obtained. A small quantity of a fairly concentrated solution of this acid, when left in an open vessel, deposits brown oxides of manganese ($xMnO_2$, $yMnO$, where $x = 20$ and y varies from 6 to 10), mixed with violet-blue crystals of the acid. The latter could not be obtained as a solid except mixed with oxides of manganese. A very dilute solution of permanganic acid can be boiled without decomposition; a solution containing about 4 per cent. of the acid deposits a brown film on glass on keeping for half an hour. More concentrated solutions decompose gradually with evolution of ozonised oxygen; when evaporated to dryness over sulphuric acid in a vacuum, they give black, almost pure, manganese dioxide.

154. "Methyl dicarboxyaconitate." By Siegfried Ruhemann.

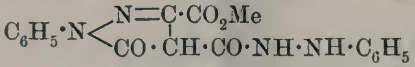
The author has found that the esters of dicarboxyaconitic acid are not produced in a manner similar to the formation of ethyl dicarboxyglutaconate, namely, by the action of the esters of trichloroacetic acid on ethyl sodiomalonate, but methyl dicarboxyaconitate,

$$CO_2Me \cdot C \colon C(CO_2Me)_2 \cdot CH(CO_2Me)_2,$$

was prepared according to the directions of Auschütz and Deschauer (*Annalen*, 1906, **347**, 3).

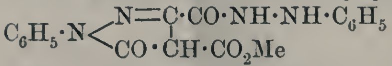
Phenylhydrazine reacts with the ester at the ordinary temperature to yield the *additive* product $CO_2Me \cdot C(NH \cdot NH \cdot C_6H_5)[CH(CO_2Me)_2]_2$ (colourless prisms, m. p. 135°). This is fairly stable, but is decomposed when it is digested with dilute caustic potash or boiled with sodium carbonate with formation of malonic acid and *monomethyl phenylpyrazolonedicarboxylate* (colourless prisms which melt and decompose at 201—202°). The author considers that the formula of this ester is  $C_6H_5\cdot N\Big<\begin{matrix}N{=}C\cdot CO_2H\\ CO\cdot CH\cdot CO_2Me\end{matrix}$. On boiling with concentrated, aqueous potassium hydroxide, it furnishes potassium 1-phenyl-5-pyrazolone-3-carboxylate,  $C_6H_5\cdot N\Big<\begin{matrix}N{=}C\cdot CO_2K\\ CO\cdot CH_2\end{matrix}$.

At 100°, phenylhydrazine and methyl dicarboxyaconitate form, besides methyl malonate, the compound $C_{24}H_{24}O_4N_6$. This, with dilute hydrochloric acid, yields phenylhydrazine hydrochloride and the *phenylhydrazide* of *monomethyl phenylpyrazolonedicarboxylate,*



$$C_6H_5\cdot N\Big<\begin{matrix}N{=}C\cdot CO_2Me\\ CO\cdot CH\cdot CO\cdot NH\cdot NH\cdot C_6H_5\end{matrix}$$

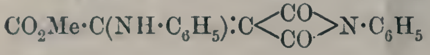
or



$$C_6H_5\cdot N\Big<\begin{matrix}N{=}C\cdot CO\cdot NH\cdot NH\cdot C_6H_5\\ CO\cdot CH\cdot CO_2Me\end{matrix}$$

(colourless needles which decompose on heating).

The compound $C_{24}H_{24}O_4N_6$ therefore is the *phenylhydrazine* salt of this substance.

Methyl dicarboxyaconitate, on being heated with aniline at 100°, is decomposed, and furnishes *carboxymethylanilinomethylenemalonanil,*  $CO_2Me\cdot C(NH\cdot C_6H_5){:}C\Big<\begin{matrix}CO\\ CO\end{matrix}\Big>N\cdot C_6H_5$ (canary-yellow prisms, m. p. 194°).

155. "The action of heat on α-hydroxycarboxylic acids. Part III. αα′-Dihydroxysebacic acid and its diacetyl derivative." By Henry Rondel Le Sueur.

The author has now extended his investigation of the action of heat on α-hydroxy-acids to the hydroxy-derivatives of dibasic acids. When αα′-dihydroxysebacic acid or its diacetyl derivative is heated at 250—270°, it decomposes with evolution of carbon monoxide and formation of the dialdehyde of suberic acid:

$$CO_2H\cdot CH(OH)\cdot[CH_2]_6\cdot CH(OH)\cdot CO_2H \longrightarrow CHO\cdot[CH_2]_6\cdot CHO.$$

156. "Dihydroxyadipic acids. (Preliminary note.)"
By Henry Rondel Le Sueur.

When the bromine atoms in αα′-dibromoadipic acid are replaced by hydroxyl groups, two dihydroxyadipic acids are obtained, one melting at 146° and the other at 174°. Both form insoluble, crystalline silver salts, and when the acid melting at 146° is heated, it loses water with formation of a dilactone which sublimes in well-defined plates.

As αα′-dihydroxyadipic acid contains two asymmetric carbon atoms, it is probable that the above acids are stereoisomerides.

157. "The relation between absorption spectra and optical rotatory power. Part II. The tartaric acids." By Alfred Walter Stewart.

The absorption spectra of the two active forms of tartaric acid are identical, and show only slight general absorption. When an equimolecular mixture of the two antipodes containing the same weight of acid as in the previous cases is used, a greater general absorption is found, proving that racemic acid has a greater power of absorption than either active form. When the racemic acid solution is diluted, however, its absorptive power gradually approximates to that of the active acids, with which it eventually becomes identical. This shows that in dilute solution the racemic acid is broken down into the two active forms, as has already been suspected from results obtained in freezing point, boiling point, and vapour density determinations. These spectroscopic results were corroborated by somewhat similar ones obtained with the active limonenes and dipentene. As a double salt above and below its temperature of transition furnishes the closest parallel to a solution which may contain either a mixture of two antipodes or a racemic compound, the spectrum of astrakanite above and below 22° was examined. It was found that above this temperature an absorptivo power was shown differing from that observed below 22°, so that the two cases are evidently analogous. This also furnishes a new method of determining transition temperatures. It was found that *i*-tartaric acid had the strongest absorptive power of all, being much more absorbent than racemic acid. No absorption bands were found in any of the spectra. Applications of this work to various questions, such as the determination of existence limits in the case of racemic compounds, the proof of the actual formation of a liquid racemic compound (as distinct from an inactive equimolecular mixture), and the existence of pseudo-racemic compounds were discussed.

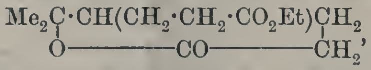
158. "Experiments on the synthesis of the terpenes. Part XI. Synthesis of 4-*iso*propylidene*cyclo*hexanone and its derivatives." By William Henry Perkin, jun., and John Lionel Simonsen.

The sodium derivative of ethyl α-acetylglutarate,

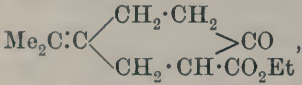
$$CO_2Et\cdot CHNa(COMe)CH_2\cdot CH_2\cdot CO_2Et,$$

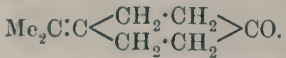
reacts readily with ethyl β-iodopropionate with the formation of *ethyl γ-acetylpentane-αγε-tricarboxylate*,

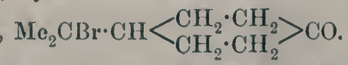
$$\mathrm{CO_2Et\cdot C(COMe)(CH_2\cdot CH_2\cdot CO_2Et)_2},$$

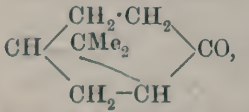
which distils at 217° (15 mm.), and on hydrolysis with hydrochloric acid is converted into *γ-acetylpimelic acid*, $\mathrm{COMe\cdot CH(CH_2\cdot CH_2\cdot CO_2H)_2}$. This acid is a colourless syrup which yields a *semicarbazone* melting at 177°. When ethyl γ-acetylpimelate is treated with magnesium methyl iodide, it is converted into the lactone of *ethyl hydrogen γ-iso**propenolpimelate*,  $\begin{array}{l}\mathrm{Me_2C\cdot CH(CH_2\cdot CH_2\cdot CO_2Et)CH_2} \\ \mathrm{O\text{————}CO\text{————}CH_2}\end{array}$, which distils at 200° (22 mm.), and yields, with hydrobromic acid, *ethyl hydrogen γ-(bromo*iso*propyl)pimelate*,

$$\mathrm{Me_2CBr\cdot CH(CH_2\cdot CH_2\cdot CO_2Et)CH_2\cdot CH_2\cdot CO_2H}.$$

*Ethyl γ-(bromo*iso*propyl)pimelate*, $\mathrm{Me_2CBr\cdot CH(CH_2\cdot CH_2\cdot CO_2Et)_2}$, obtained by the esterification of the latter compound, is decomposed by pyridine with formation of *ethyl γ-*iso*propylidenepimelate*, $\mathrm{Me_2C\colon C(CH_2\cdot CH_2\cdot CO_2Et)_2}$ (b. p. 168° under 13 mm.), and, on hydrolysis, yields *γ-*iso*propylidenepimelic acid*, which crystallises in prisms and melts at 97°. *Ethyl 4-*iso*propylidene*cyclo*hexanone-2-carboxylate*, 

, is obtained when the solution of ethyl γ-*iso*propylidenepimelate in toluene is treated with sodium; it decomposes on distillation, combines with hydrogen bromide to form *ethyl 4-β-bromo*iso*propyl*cyclo*hexanone-2-carboxylate*, and is hydrolysed by alcoholic potash with formation of 4-iso*propylidene*cyclo*hexanone*,  $\mathrm{Me_2C\colon C{<}\begin{array}{l}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{array}{>}CO}$.

This ketone distils at 219—221° and yields a *semicarbazone* which melts at 201°; hydrobromic acid converts it into *4-β-bromo*iso*propyl*cyclo*hexanone*,  $\mathrm{Me_2CBr\cdot CH{<}\begin{array}{l}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{array}{>}CO}$.

The object of this research was to endeavour to synthesise nopinone, 

, from the above bromo-ketone by the elimination of hydrogen bromide, but the experiments which were made in this direction have so far been unsuccessful.

159. "The purification of acetic ester." By John Kenneth Harold Inglis and Lottie Emily Knight.

Great difficulty has always been experienced in preparing pure acetic ester, and although several methods have been suggested, no one of them is satisfactory since the yield of pure ester is small and the process of preparing it laborious. For the preparation of acetoacetic ester, very nearly pure acetic ester is required, and the presence of a moderate quantity of alcohol—the most likely impurity—is fatal to success. A series of experiments has shown that the separation can be most easily carried out by first converting the alcohol into an ester of high boiling point and then distilling. If the crude ester, as obtained in the ordinary continuous process, is dried over potassium carbonate (which also removes any acetic acid) and treated with phosphoric oxide, a slow action takes place with the formation of phosphoric esters which are neither volatile nor decomposed at the boiling point of ethyl acetate (77·20° corr.). In this way a yield of 160 grams of ester boiling within one degree was obtained in an experiment in which the theoretical yield was 264 grams, that is, 60 per cent. of ester was obtained pure.

This process, however, is slow, and requires several days for completion at the ordinary temperature. On the other hand, the removal of the alcohol takes place more rapidly at the boiling point. Thus a mixture of 100 grams of ester (b. p. 76·65—77·15°) with 8 grams of absolute alcohol distilled continuously between 73° and 77°, only 21 grams passing over above 76·3°. When, however, the fractions had been mixed together and heated for half an hour with 10 grams of phosphoric oxide, using a reflux condenser, a single distillation gave 72 grams of distillate between 76·7° and 77·2°, that is, 72 per cent. of an approximately pure substance. This result shows that it is easy to obtain by this method a good yield of acetic ester boiling within 0·5°; and it was found that an ester of this purity gave a good yield of acetoacetic ester.

160. "Solubility of lead sulphate in concentrated solutions of ammonium acetate (Preliminary note)." By John Jacob Fox.

Solubility experiments were carried out with the view of determining the course of the reaction occurring between ammonium acetate and lead sulphate. The solid phases were examined to ascertain whether they changed during the solution. The following are some of the results obtained from the analysis of the solutions saturated at 24·9°, the concentration of the ammonium acetate varying from about normal upwards:

	Molecules of salt per 1000 molecules of water.		
Density of solution.	Ammonium acetate.	Ammonium sulphate.	Lead acetate.
1·0197	20·0	0·54	0·52
1·0320	31·2	0·93	0·92
1·0457	44·5	1·49	1·46
1·0578	55·6	2·11	2·08
1·0694	68·5	2·77	2·74
1·1094	94·1	2·77	6·31
1·1281	133·3	2·80	8·10

The curve obtained does not agree with the formula developed by Noyes (*Amer. Chem. Soc.*, 1905, **27**, 747), the solubility being greater than that given by the formula. The solid phase consisted of lead sulphate and was unaltered with concentrations of ammonium acetate up to rather more than $3N$, but with more concentrated ammonium acetate, well-defined crystals of lead ammonium sulphate,

$$Pb(NH_4)_2(SO_4)_2,$$

were obtained.

The solubility of the lead sulphate increased considerably with ammonium acetate of greater concentrations than above, and the solid phases consisted of mixtures of lead sulphate and lead ammonium sulphate. The lead is probably present in solution as lead acetate, since the amount of sulphate in solution gradually became less than the equivalent of the lead present as the concentration of the ammonium acetate was increased beyond $3N$.

161. "Researches on morphine." Part III.

By Frederic Herbert Lees.

In continuation of previous work (Schryver and Lees, *Trans.*, 1900, **77**, 1024; 1901, **79**, 563, and Lees and Tutin, *Proc.*, 1906, **22**, 253), the author has shown that chloromorphide and bromomorphide yield chlorocodeide and bromocodeide respectively on methylation, the two latter bases previously obtained by other methods being simply the codeine analogues of the two former bases.

By the hydrolysis of chloromorphide, the author has isolated, besides *β-iso*morphine, an hitherto undescribed isomeride of morphine previously indicated by the hydrochloride ($[\alpha]_D$ $-92·5°$) obtained by Schryver and Lees. On methylation, this new base gives the so-called "ψ-codeine" (compare Merck, *Arch. Pharm.*, 1891, **229**, 161; Vongerichten, *Ber.*, 1903, **36**, 1591, and Knorr and Hörlein, *Ber.*, 1906, **39**, 4409).

As the name ψ-morphine belongs to a well known oxidation product of morphine of which Merck's "ψ-codeine" is not the methyl ether or codeine analogue, the author has termed the new isomeride of morphine, *neoisomorphine* and its methyl ether, *neoisocodeine.*

*Neo*iso*morphine*, $C_{17}H_{19}O_3N$, crystallises from alcohol in brilliant, prismatic needles containing one molecule of the solvent (m. p. 278°); its *hydrochloride*, $C_{17}H_{19}O_3N,HCl$, forms anhydrous crystals from alcohol ($[\alpha]_D$ − 79·1° in water); its *methiodide*, $C_{17}H_{19}O_3N,MeI$, forms glistening crystals from alcohol (m. p. 297°; $[\alpha]_D$ − 54·5° in water).

*Neo*iso*codeine*, $C_{18}H_{21}O_3N$, forms large colourless prisms from ethyl acetate (m. p. 181—182°; $[\alpha]_D$ − 96·6° in alcohol).

*β-iso*Morphine on methylation furnishes *β*-iso*codeine*, $C_{18}H_{21}O_3N$, which did not crystallise. The *methiodide*, $C_{18}H_{21}O_3N,MeI$, forms tabular crystals from water (m. p. 215—216°; $[\alpha]_D$ − 145·5° in water), and on boiling with sodium hydroxide readily yields a methine base.

It was also shown that the "*A-Base*" (m. p. 147—147·5°; $[\alpha]_D$ − 205·5° in chloroform) previously obtained by Lees and Tutin (*loc. cit.*) together with *iso*codeine (m. p. 171—172°; $[\alpha]_D$ − 155° in chloroform) by the hydrolysis of bromocodeide as a definite substance, not resolvable by recrystallisation, is in reality a molecular combination of *iso*codeine and *β-iso*codeine.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

British Guiana. Report of the Commission appointed to enquire into and report upon the general and infantile mortality; together with minutes of the sittings, evidence of witnesses, &c. pp. viii + 154. Georgetown, Demerara. 1906. (*Recd.* 1/7/7.)

From His Excellency the Governor of the Colony of British Guiana.

Geneva, *University of.* Séance solennelle de distribution des prix de Concours, 28 Janvier, 1907. Rapports du Recteur et des Jurys précédés d'une notice biographique sur Humphry Davy [par Philippe A. Guye]. pp. 96. Genève 1907. (*Recd.* 10/6/6.)

From Professor Philippe A. Guye.

Neumann, *Bernhard.* Elektrometallurgie des Eisens. pp. x + 176. ill. Hall a S. 1907. (*Recd.* 21/6/7.) From Dr. F. M. Perkin.

Zeitschrift für anorganische Chemie. Edited by *G.* **Krüss.** Vol. I. Hamburg 1892. (*Recd.* 26/6/7.) From Professor J. W. Mallet.

THE LIBRARY.

The Library will be closed throughout the month of August, when the Society's Rooms will be redecorated, and the annual revision of the volumes will take place.

Fellows are particularly requested to return all Library Books in their possession *not later than Wednesday, July 31st.*

LIST OF FELLOWS, 1907.

The List of Fellows for 1907 is now in active preparation, and changes of address *received after 31st July cannot be included in it.*

In order that the new list may be as complete as possible, those Fellows whose degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

CORRECTION.

1907. Page 144, lines 1 and 2 from top: Dr. Divers finds himself to have been in error when he assumed that Messrs. Barlow and Pope had allowed no valency to the oxygen in hydroxyl. He had read literally their expression 2Mg(F)(OH) (*Trans.*, 1906, **89**, 1686), instead of as 2Mg with 1F and 1(OH), as was intended by the authors it should be read.

The next Ordinary Meeting will be held on **Thursday**, October **24th**, 1907, at **8·30** p.m.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK

Issued 4/11/07

PROCEEDINGS

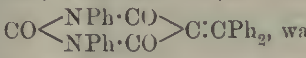
OF THE

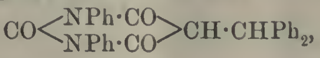
CHEMICAL SOCIETY.

Vol. 23. No. 330.

The following are abstracts of papers received during the vacation, and published or passed for publication in the *Transactions.*

162. "Studies in the barbituric acid series. I. :3-Diphenylbarbituric acid and some coloured derivatives." By Martha Annie Whiteley. Trans., 1907, 1330.)

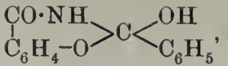
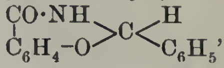
In addition to the coloured derivatives of 1 : 3-diphenylbarbituric acid already described (*Proc.*, 1906, **22**, 200 ; 1907, **23**, 180), 1 : 3-*diphenyl-5-diphenylmethylenebarbituric acid*,  $\mathrm{CO}<^{\mathrm{NPh\cdot CO}}_{\mathrm{NPh\cdot CO}}>\mathrm{C{:}CPh_2}$, was prepared from 1 : 3-diphenylbarbituric acid and benzophenone dichloride ; it forms yellow prisms melting at 264°, and, like the similarly constituted benzylidene derivative, yields a colourless acid, 1 : 3-*diphenyl-5-diphenylmethylbarbituric acid,*

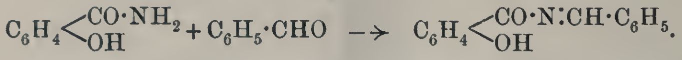


$$\mathrm{CO}<^{\mathrm{NPh\cdot CO}}_{\mathrm{NPh\cdot CO}}>\mathrm{CH\cdot CHPh_2},$$

m. p. 205—206°, on reduction.

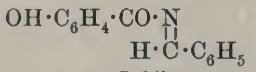
163. "Phenylbenzometoxazone and related derivatives." By Arthur Walsh Titherley. (Trans., 1907, 1419.)

According to McConnan and Titherley (*Trans.*, 1906, **89**, 1318), *O*- and *N*-acylsalicylamides are labile and mutually transformable through an intermediate cyclic metoxazone structure. The alternative tautomeric formula for *N*-benzoylsalicylamide is , and the related compound, phenylbenzometoxazone, , has been isolated by the condensation of salicylamide and benzaldehyde by means of alcoholic hydrogen chloride (compare Keane and Nicholls, *Trans.*, 1907, **91**, 266). The relation between phenylbenzometoxazone and *N*-benzoylsalicylamide is confirmed by the fact that the former passes into the latter on careful oxidation. When salicylamide and benzaldehyde condense in presence of anhydrous sodium acetate, benzylidenesalicylamide results as well as phenylbenzometoxazone:



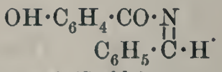
$$C_6H_4{<}\substack{CO\cdot NH_2\\ OH} + C_6H_5\cdot CHO \longrightarrow C_6H_4{<}\substack{CO\cdot N{:}CH\cdot C_6H_5\\ OH}.$$

An isomeric benzylidenesalicylamide has also been obtained by rearrangement of phenylbenzometoxazone with pyridine and alkali. The two isomerides are amorphous and similar in physical properties, but differ markedly in stability; that produced by condensation is stable, but the other, derived from phenylbenzometazone, rearranges completely into this compound on melting. The two benzylidenesalicylamides are probably geometrical isomerides:



$$\begin{array}{l} OH\cdot C_6H_4\cdot CO\cdot N \\ \qquad\qquad\quad \| \\ \qquad\quad H\cdot C\cdot C_6H_5 \end{array}$$

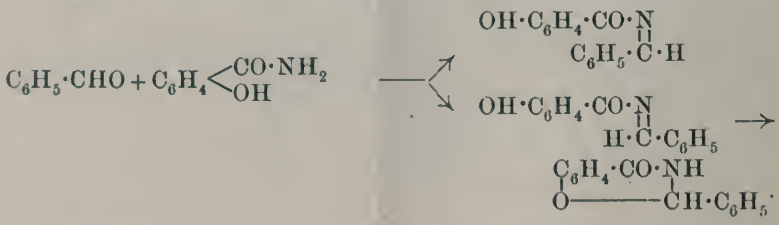
syn- (Labile)
Benzylidenesalicylamide.



$$\begin{array}{l} OH\cdot C_6H_4\cdot CO\cdot N \\ \qquad\qquad\quad \| \\ \qquad C_6H_5\cdot C\cdot H \end{array}$$

anti- (Stable)
Benzylidenesalicylamide.

The production of phenylbenzometoxazone in the condensation of benzaldehyde and salicylamide evidently takes place through the rearrangement of *syn*-benzylidenesalicylamide first formed, so that the mechanism in presence of sodium acetate may be represented:



The reversible relation which exists between the *syn*-open-chain formula and the ring (metoxazone) affords striking confirmation of McConnan and Titherley's theory (*loc. cit.*) of cyclic metoxazone tautomerism as applied to the acylsalicylamide group.

Amorphous syn-*benzylidenesalicylamide* on boiling with alcohol or acetic acid becomes crystalline and then melts at 182°. In acetone solution, it gives a violet ferric chloride reaction. anti-*Benzylidene-salicylamide*, which has not been obtained crystalline, gives a similar reaction. Both yield *sodium* salts and *benzoyl* derivatives.

164. "The application of Baeyer's reduction to benzoin and its derivatives." By James Colquhoun Irvine and John Weir.

(Trans., 1907, 1384.)

Baeyer's method of reduction has been applied to benzoin and to a number of its derivatives. In every case, stilbene was obtained as the final product, irrespective of the nature of the side-chains present in the compound reduced. As in previous reductions of a similar nature, it has been shown that the reactions proceeded through the intermediate formation of deoxybenzoin. The reduction of benzoin to either stilbene or deoxybenzoin can be so readily controlled that the process can be used as a method of preparing these compounds, the yield being in each case about 60 per cent. of the theoretical amount.

In preparing benzoin methyl ether by Fischer's process (*Ber.*, 1893, **26**, 2412), two compounds were isolated which appear to be products of complicated side-reactions. One of these substances, which melted at 185°, is a condensation compound produced by the union of a molecule of benzoin with one of benzoin methyl ether with loss of water. The other compound (m. p. 285°) is regarded s a tetramethylene derivative produced by the union of two molecules of benzoin methyl ether. The mode of its formation resembles that of the benzoin condensation, and seems to depend on the action of nitriles present as impurities in the benzoin used.

165. "Aromatic azoimides. Part II. Ortho- and meta-hydroxyphenylazoimides." By Martin Onslow Forster and Hans Eduard Fierz. (Trans., 1907, 1350.)

o-*Hydroxyphenylazoimide*, $HO\cdot C_6H_4\cdot N_3$, prepared by the action of hydroxylamine on diazotised *o*-aminophenol, crystallises in colourless needles containing $\frac{1}{2}H_2O$; it quickly becomes brown when exposed to light, darkens at 120—130°, and detonates vigorously at 140—145°. The *sodium* derivative is colourless, and does not change into a blue variety corresponding to the blue potassium derivative of *p*-hydroxyphenylazoimide. The *benzoyl*, p-*nitrobenzoyl*, and p-*toluenesulphonic* derivatives melt at 45°, 101°, and 72° respectively.

m-*Hydroxyphenylazoimide*, produced from diazotised *m*-aminophenol and either hydroxylamine or hydrazoic acid, crystallises from petroleum in colourless needles which melt at 36·5° and quickly become brown when exposed to light; the *benzoyl* and p-*nitrobenzoyl* derivatives melt at 50° and 136° respectively.

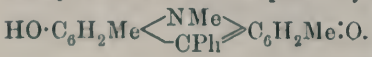
166. “The influence of mercuric iodide on the formation of sulphonium iodides.” By Thomas Percy Hilditch and Samuel Smiles. (Trans., 1907, 1394.)

Many sulphonium bases are difficult to obtain by the usual method namely, the addition of alkyl halide to sulphide, owing to the secondary action of the alkyl halide with the sulphonium salt as the latter is formed, and the authors have shown that ethyl disulphide and ethyl iodide, at the ordinary temperature, furnish triethylsulphonium iodide. Such instances as this are usually found where the initial addition of alkyl iodide proceeds slowly. The formation of sulphonium bases, however, is greatly accelerated if the reaction is carried out in presence of mercuric iodide; and in this way, the sulphonium salt can be isolated before the secondary action of the alkyl halide has set in. Thus ethyl disulphide and ethyl iodide in presence of mercuric iodide yield diethylthioethylsulphonium, $(C_2H_5)_3S_2I,2HgI_2$, and dibenzyl sulphide with methyl or ethyl iodide and mercuric iodide furnishes the compounds $(C_7H_7)_2(CH_3)SI,HgI_2$ and $(C_7H_7)_2(C_2H_5)SI,HgI_2$.

167. “Benzoflavol (2 : 8-dihydroxy-5-phenyl-3 : 7-dimethylacridine).” By Albert Ernest Dunstan and Louisa Cleaverley. (Trans., 1907, 1619.)

Following the method laid down by Dunstan and Hewitt (*Trans.*, 1906, **89**, 1472), the authors have prepared 2 : 8-*dihydroxy*-5-*phenyl*-3 : 7-*dimethylacridine* (*benzoflavol*) from benzoflavine. The *sulphate*, *dichromate*, *platinichloride*, and *picrate* were described.

On benzoylation, benzoflavol yields a *dibenzoyl* derivative, and on acetylation a *diacetyl* derivative, m. p. 239—242°. The latter, on methylation and subsequent hydrolysis, furnishes the *anhydro-base*,



$$\mathrm{HO{\cdot}C_6H_2Me}{<}\begin{smallmatrix}\mathrm{NMe}\\ \mathrm{CPh}\end{smallmatrix}{>}\mathrm{C_6H_2Me{:}O}.$$

168. “The action of bromine on 5-phenylacridine and its halogen derivatives.” By Albert Ernest Dunstan and Thomas Percy Hilditch. (Trans., 1907, 1659.)

The following compounds have been prepared and submitted to the action of bromine: (1) 5-*p*-chlorophenylacridine; (2) 5-*p*-bromo-phenylacridine; (3) 5-phenylacridine; (4) monobromophenylacridine. The resulting compounds have been methylated either by methyl iodide or dimethyl sulphate. Substances (1) and (2) gave dibromo-derivatives which lost bromine on treatment with dimethyl sulphate. Substance (3) gave a tribromophenylacridine which, with dimethyl sulphate, also lost bromine. Substance (4) was normally methylated. The authors conclude that these bromine derivatives are additive (compare Senier and Austin, *Trans.*, 1904, **85**, 1196), the added atoms occupying the para-meso-positions.

169. "The relation between viscosity and chemical constitution. Part I. The viscosity of pyridine solutions." By Albert Ernest Dunstan, Ferdinand Bernard Theodore Thole, and John Samuel Hunt. (Trans., 1907, 1728.)

The authors have applied the methods and results of Dunstan (*Trans*, 1904, **85**, 817; 1905, **87**, 11; 1907, **91**, 83) to solutions of pyridine, α- and β-picoline, and 2:6-lutidine in various solvents. These bases in aqueous solution give curves which exhibit maxima, the discontinuities being at points of simple molecular concentration. These maxima are attributed to the addition of the elements of water at the nitrogen atom of the pyridine, or its homologues.

170. "The atomic volumes of phosphorus." By Edmund Brydges Rudhall Prideaux. (Trans., 1907, 1711.)

The author has determined the coefficients of expansion of phosphorus and phosphorus pentachloride, and has calculated the values of the constants from the equations $V_t = V_0(1 + \alpha t + \beta t^2)$, expressing the expansion of phosphorus between 60° and 235°, and $V_t = V_0(1 + \alpha t)$, expressing the expansion of phosphorus pentachloride between 160° and 190°. From these equations, values are obtained for the specific volumes of phosphorus and phosphorus pentachloride at their respective boiling points.

The atomic volume of quinquevalent phosphorus can thus be compared with those of tervalent and elementary phosphorus.

171. "The action of potassium sulphite on potassium tetrathionate in aqueous solution." By Arthur Colefax.

By the joint estimation of the iodine titration and the acidity developed in the solution when the iodine titration is completed, the nature of the interaction of potassium sulphite and tetrathionate in aqueous solution has been investigated.

If potassium sulphite and tetrathionate react in equimolecular proportions in aqueous solution, the conversion of sulphite into thiosulphate and consequent formation of trithionate which occurs does not proceed to completion, and pentathionate is not permanently formed in the solution. If the relative proportions in which these bodies are originally present in the solution are either $K_2SO_3 : \frac{1}{2}K_2S_4O_6$, or $K_2SO_3 : 2K_2S_4O_6$, the theoretically complete conversion of sulphite into thiosulphate takes place. In the latter case, where the proportions are $K_2SO_3 : 2K_2S_4O_6$ when the sulphite has been completely converted into thiosulphate, pentathionate is found in the solution in considerable amount.

Certain preliminary experiments established that (*a*) potassium sulphite and trithionate do not react in aqueous solution ; (*b*) potassium thiosulphate and tetrathionate react in aqueous solution to form pentathionate, the resulting sulphite being immediately reconverted into thiosulphate ; (*c*) potassium thiosulphate and trithionate react in aqueous solution, although to an extremely small extent, and (*d*) potassium sulphite rapidly abstracts sulphur from pentathionate when the two salts react in aqueous solution.

172. "The adsorption of iodine by carbon." By Oliver Charles Minty Davis. (Trans., 1907, 1666.)

An investigation has been carried out on the adsorption of iodine, dissolved in various organic solvents, by means of animal, sugar, and cocoanut charcoal.

The main objects of the research were to investigate the effect of temperature and time on the amount of adsorption, and to compare the adsorbing values of the three forms of carbon.

The effect of temperature was found to be very small, but that of time was well marked.

The experiments demonstrate the fact that adsorption, although rapid at first, proceeds slowly for lengthened periods after a "surface equilibrium" has been maintained, proving that both surface action and diffusion are concerned in the mechanism of adsorption.

The adsorbing values of animal and sugar carbon are roughly the same, whilst that of cocoanut carbon is much less than these.

173. “Adsorption formulæ.” By James William McBain.

(Trans., 1907, 1683.)

The results of recent work on adsorption have been expressed by either of the following two formulæ, which are applicable to gases or solutions :

$$\text{I.}\quad \frac{x}{m} = \beta c^{1/p} = \beta\left(\frac{a-x}{v}\right)^{1/p}$$

$$\text{II.}\quad \lambda = \frac{v}{m} ln \frac{a}{a-x} = \alpha\left(\frac{a}{v}\right)^{-1/n},$$

where x is the amount of substance adsorbed, a is the total amount of that substance, $\frac{a-x}{v} = c$ its concentration in the fluid phase, m the weight of adsorbing substance, and λ, β, α, p, and n are constants.

There are, however, some very serious disadvantages inherent in the use of the λ-formula, whereby an equilibrium is referred to a parameter a/v with which it has no apparent connexion. This expression, introduced to represent the amount of adsorption, does not lead to any definite number characteristic of each set of substances, and, moreover, its results are irreconcilable with each other and with experiment.

174. “The diazo-derivatives of benzenesulphonylbenzidine.” By Gilbert T. Morgan and James Morton Hird. (Trans., 1907, 1505.)

Benzenesulphonylbenzidine and as-*benzenesulphonylmethylbenzidine*, $C_6H_5{\cdot}SO_2{\cdot}N(CH_3){\cdot}C_6H_4{\cdot}C_6H_4{\cdot}NH_2$, give rise to stable, coloured diazonium salts; those derived from the latter base are of interest in connexion with the formulæ recently put forward for diazonium derivatives, because they show that the presence of a labile hydrogen atom is not necessary for the development of colour in this series of substances.

175. “The interactions of aromatic amines and para-diazoimides.” By Gilbert T. Morgan and Frances M. G. Micklethwait.

(Trans., 1907, 1512.)

The para-diazoimides recently described by the authors combine additively with the more reactive aromatic amines to give rise to aminoazo-compounds.

This combination occurs in some instances when the reagent are intimately mixed in the dry state, the reaction being accelerated by the addition of a small amount of pyridine. Benzenesulphonyl-*p*-phenylenediazoimide combines in this way with α- and β-naphthylamines and certain of their derivatives, but the reaction does not take place with aniline and its homologues.

176. "Molecular aggregation in solution as exemplified in aqueous mixtures of sulphuric acid with inorganic sulphates." By John Holmes and Philip John Sageman. (Trans., 1907, 1606.)

The authors have determined the volumetric data of a series of mixtures of dilute sulphuric acid with aqueous solutions of neutral inorganic sulphates. In all cases, the volume of the mixture was found to be greater than the sum of the initial volumes.

From a consideration of the results obtained, the authors conclude that the volumetric changes are due to physical forces inherent to the molecules, and this theory is supported by a comparison with the results obtained in mixtures in which chemical change is known to occur.

By elimination of extraneous influences due to the solution medium, the relative aggregations of the interacting molecules can be determined.

177. "The wandering of bromine in the chlorination of bromoanilines." By Walter William Reed and Kennedy Joseph Previté Orton. (Trans., 1907, 1543.)

When *p*-bromoaniline is directly chlorinated, the normal product, 2 : 6-dichloro-4-bromoaniline, is not alone formed. Partial displacement of the bromine by the chlorine takes place, and a mixture of chlorodibromo-, dichlorobromo-, and *s*-trichloro-anilines results, which cannot be resolved into its constituents. Such a reaction does not occur only when excess of chlorine is used, but also with the calculated quantity of the reagent. The solvent has little effect, the same mixture being obtained when 20 per cent. hydrochloric acid or such anhydrous solvents as benzene, chloroform, or carbon tetrachloride are employed. Similar results were observed on treatment of 2 : 4-dibromoaniline with one molecular proportion of chlorine, *s*-tribromoaniline being among the products of the change. *o*-Bromo-, *m*-bromo-, and 2 : 6-dibromo-aniline, on the other hand, yield respectively only a single chlorinated product.

2 : 6-Dichlorobromoaniline can be obtained indirectly by two methods, either by molecular rearrangement of acetylchloroamino-2-

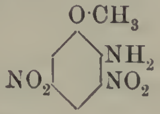
chloro-4-bromobenzene which yields the acetyl derivative of the aniline, or by the action of acetylchloroamino-2 : 4-dichlorobenzene on *p*-bromoaniline, when 2 : 4-dichloroacetanilide and 2 : 6-dichloro-4-bromoaniline are formed :

$$C_6H_4Br\cdot NH_2 + 2C_6H_3Cl_2\cdot NClAc = C_6H_2Cl_2Br\cdot NH_2 + 2C_6H_3Cl_2\cdot NHAc.$$

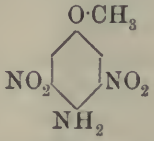
178. "The diazotisation of dinitroanisidines and related compounds." By Raphael Meldola and James Gordon Hay.

(Trans., 1907, 1474.)

As the result of former researches, the conclusion has been reached that the configuration essential for the displacement of a nitro-group on diazotisation is that the mobile group must not only be in the ortho- or para-position with respect to the amino-group, but that there must also be another nitro-group or acid substituent in a position adjacent to the mobile group. When these conditions are not fulfilled and the methoxy-group is in the ortho- or para-position with respect to the amino-group with a nitro-group adjacent, then on diazotisation a diazo-oxide (quinonediazide) is formed with the elimination of the methyl(methoxy) group. Two instances of this type of "diazo-reaction" have been studied, and in confirmation of the general conclusions the authors have found that the two dinitro-anisidines,



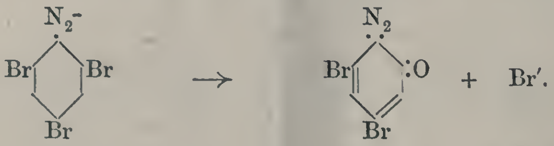
and



in which neither of the two sets of conditions above indicated is fulfilled, behave normally on diazotisation, losing neither nitro- nor methoxy-group. In the course of the present research, the authors have prepared 2 : 3-dinitro-4-aminophenol, the N-*acetyl* derivative of which crystallises in yellow needles melting at 199·5°. The free base is unstable and could not be isolated. A comparative study of the products of diazotisation of this and the corresponding dinitro-*p*-anisidine has brought out very clearly the "loosening" influence of the methyl group on the nitro-group, since under conditions in which the dinitroanisidine loses a nitro-group on diazotisation the dinitroaminophenol retains both nitro-groups. The 2 : 3 : 5-*trinitroaminophenol*, of which the acetyl derivative was described in a paper recently published by one of the authors (*Trans.*, 1906, **89**, 1935), has also been isolated, and the products of its diazotisation studied in a preliminary way.

179. "Isomeric change in benzene derivatives. Replacement of halogen by hydroxyl in chlorobromodiazobenzenes." By Kennedy Joseph Previté Orton and Walter William Reed.
(Trans., 1907, 1554.)

In continuation of earlier work (Orton, *Proc. Roy. Soc.*, 1902, **71**, 153; Proc., 1902, **18**, 252; *Trans.*, 1903, **86**, 796; *ibid.*, 1905, **87**, 99) on the transformations of halogendiazobenzenes, in which an atom of halogen is replaced by hydroxyl, a quinonediazide resulting, thus:



a study has now been made of mixed symmetrical chlorobromodiazobenzenes. For this purpose, the diazo-compounds which are obtainable from 2 : 6-dichloro-4-bromo-, 2 : 4-dichloro-6-bromo-, 4-chloro-2 : 6-dibromo-, and 6-chloro-2 : 4-dibromo-anilines have been used. 3-*Chloro-5-bromo-*p-*toluidine* (which has not been hitherto described) was also prepared for the same purpose.

From these experiments, which were carried out in the manner followed previously, two facts have been elucidated. The replacement of halogen by hydroxyl is not exclusively confined to the halogen atoms which are in the ortho-position with respect to the diazo-group. Some 20 per cent. of the molecules of the diazo-compound lose an atom of halogen from the para-position, a *p*-quinonediazide being formed.

When all other conditions are alike (such as relative positions in the benzene ring, contiguity of other substituting groups, &c.), the displacement of the halogen appears to be independent of the nature of the halogen. Thus 80 per cent. of the molecules of 2 : 6-dichloro-4-bromodiazobenzene and 4-chloro-2 : 6-dibromodiazobenzene respectively lose one atom of chlorine or bromine from the ortho-position; again, 50 per cent. of the molecules of 3-chloro-5-bromo-*p*-diazotoluene lose an atom of chlorine from one ortho-position (with respect to the diazo-group) and 50 per cent. lose bromine from the other ortho position.

The authors consider that the position to which the hydroxyl becomes attached will depend rather on the general symmetry and configuration than on the nature of the halogen atom occupying the given position.

180. "A new colouring matter from Nyctanthes Arbor-tristis." B Ernest George Hill and Annoda Prasad Sirkar. (Trans., 1907, 1501.)

The flowers of *Nyctanthes Arbor-tristis* yield a yellow dye soluble in water. On heating the aqueous extract in dilute hydrochloric acid, a reddish-brown, flocculent precipitate is formed. The greater part of this is soluble in alcohol, but cannot be crystallised from this solvent. If the alcoholic solution is gently warmed with a few drops of concentrated hydrochloric acid, a bright red sediment forms and the solution loses most of its colour. This substance crystallises from pyridine or phenylhydrazine and has the formula $C_{20}H_{27}O_4$. It is slightly acid, very sparingly soluble in most solvents, but readily in alkalis. It forms the *acetyl* compound $C_{20}H_{26}O_3 \cdot C_2H_3O$, but contains no methoxyl groups. It gives neither phloroglucinol nor pyrocatechol on fusion with potassium hydroxide.

The flocculent precipitate gives a bromine compound, $C_{20}H_{15}O_{18}Br_5$, which yields bromoform on warming with potassium hydroxide.

The name *nyctanthin* is suggested for the red, crystalline substance $C_{20}H_{27}O_4$.

181 "The velocity and mechanism of the reaction between iodine and hypophosphorous acid." By Bertram Dillon Steele.

(Trans., 1907, 1641.)

The velocity and mechanism of the reaction between iodine and hypophosphorous acid have been investigated under various conditions.

It has been found that the velocity of the reaction is independent of the concentration of the iodine provided this does not fall below a certain limiting value. This behaviour is best explained by the supposed occurrence of consecutive reactions of such a nature that the iodine takes no part in the slower or controlling reaction.

The reaction is unimolecular with respect to the hypophosphorous acid and it is catalytically accelerated by hydrogen ions, the velocity under certain conditions being directly proportional to the concentration of the latter.

Since hydrogen ions are formed during the course of the reaction, the latter becomes autocatalytically accelerated in the absence of any large initial concentration of acid.

The further oxidation of phosphorous acid to phosphoric acid by iodine is one which is retarded by the presence of hydrogen ions. It should furnish therefore an example of autocatalytic retardation.

182. "Succinic acid and its potassium salts." By Hugh Marshall and Alexander Thomas Cameron. (Trans., 1907, 1519.)

In a previous paper (*Proc. Roy. Soc. Edin.*, 1905, **25**, 401), Cameron described the preparation of crystals of acid potassium succinate showing curved faces. The authors have now continued that research, giving further particulars of these curved crystals, and, more particularly, a description of the pure potassium salts themselves, since trustworthy data concerning these have not hitherto been published. The conditions of equilibrium for aqueous solutions containing potassium and hydrogen succinates were studied at various temperatures. At the ordinary temperature, solutions having the composition of the superacid salt, $KH_3(C_4H_4O_4)_2$, first deposit succinic acid; solutions having the composition of the acid salt, $KHC_4H_4O_4$, first deposit the superacid salt. Above 30—35°, however, the acid salt is in equilibrium with a solution having a similar composition, and it would also appear that at a considerably higher temperature the same is true for the superacid salt.

It seems probable from the results obtained that the superacid salt is not merely a "molecular" compound, but that the complex ion $H_3C_4H_4O_4'$ exists in considerable proportion in the solution, especially at higher temperatures.

The acid salts, $KHC_4H_4O_4$, $KHC_4H_4O_4,2H_2O$, and $KH_3(C_4H_4O_4)_2$, were examined crystallographically; these, with the normal salt, $K_2C_4H_4O_4,2H_2O$, were the only potassium salts of succinic acid obtained within the limits of temperature covered by the investigation.

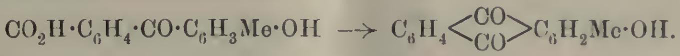
183. "The fluoresceins and eosins from 4-hydroxyphthalic, 4-methoxyphthalic, and hemipinic acids." By Arthur Friedl, Charles Weizmann, and Max Wyler. (Trans., 1907, 1584.)

Resorcinol condenses readily with 4-hydroxyphthalic, 4-methoxyphthalic, and hemipinic acids, yielding the corresponding *hydroxy-*, *methoxy-*, and *dimethoxy-fluoresceins.* Hydroxyfluorescein is very slightly fluorescent, whereas methoxyfluorescein, like ordinary fluorescein, is extremely so. Dimethoxyfluorescein is much less fluorescent than is methoxyfluorescein.

The corresponding tetrabromo-derivatives of these fluoresceins show corresponding differences in their fluorescent properties.

184. "Researches on anthraquinones and phthaleins." By William Henry Bentley, Henry Dent Gardner, jun., and Charles Weizmann. (Trans., 1907, 1626.)

Hydroxymethylanthraquinones can be prepared in two stages from phthalic acid (or its derivatives) and the cresols (or their methyl ethers). A derivative of benzoylbenzoic acid is first prepared and subsequently condensed by sulphuric acid to the corresponding hydroxymethylanthraquinone:



$$CO_2H{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_3Me{\cdot}OH \longrightarrow C_6H_4{<}{\substack{CO\\CO}}{>}C_6H_2Me{\cdot}OH.$$

The authors have employed two condensing agents for bringing about the first reaction, namely, (1) boric acid and (2) aluminium chloride, obtaining different results in each case where this was possible. Boric acid promotes condensation in the ortho-position, whereas aluminium chloride causes condensation to take place in the para-position with respect to the hydroxyl group.

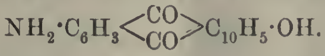
A number of condensations of phthalic and hydroxyphthalic acids with the three cresols and *m*-4-xylenol have been effected.

185. "Derivatives of naphthacenequinone. Part II." By William Henry Bentley, Arthur Friedl, and Charles Weizmann (Trans., 1907, 1588.)

The two nitrophthalic acids condense with *a*-naphthol, yielding nitrohydroxynaphthoylbenzoic acids,

$$NO_2{\cdot}C_6H_3(CO_2H){\cdot}CO{\cdot}C_{10}H_6{\cdot}OH,$$

which on reduction yield the corresponding amino-acids; the latter condense in sulphuric acid to aminohydroxynaphthacenequinones, which thus contain the amino-group in the benzene ring:



$$NH_2{\cdot}C_6H_3{<}{\substack{CO\\CO}}{>}C_{10}H_5{\cdot}OH.$$

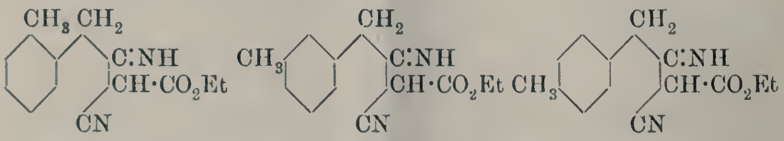
These derivatives dissolve in concentrated sulphuric acid with a much bluer, and in alcoholic potash with a much yellower, colour than is exhibited by 1-amino-6-hydroxynaphthacenequinone, which contains the amino-group in the naphthalene ring.

Hemipinic acid condenses with *a*-naphthol, yielding *hydroxydimethoxynaphthoylbenzoic acid*, $(CH_3{\cdot}O)_2C_6H_2(CO_2H){\cdot}CO{\cdot}C_{10}H_6{\cdot}OH$, which when heated with sulphuric acid appears to hydrolyse and also oxidise during the condensation, the product on analysis giving numbers corresponding with *trihydroxymonomethoxynaphthacenequinone.*

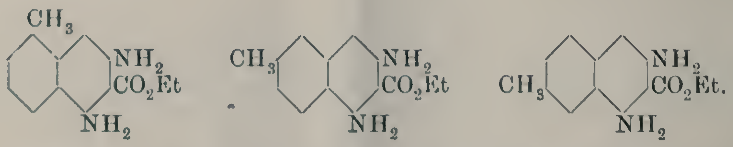
1 : 5-Dihydroxynaphthalene, being a di-α-naphthol, can condense with two molecules of phthalic acid, yielding *dicarboxybenzoyldihydroxynaphthalene*, $CO_2H\cdot C_6H_4\cdot CO\cdot C_{10}H_4(OH)_2\cdot CO\cdot C_6H_4\cdot CO_2H$. This acid, however, on condensation with sulphuric acid appears to lose one phthalic acid group, yielding a *trihydroxynaphthacenequinone.*

186. "The formation and reactions of imino-compounds. Part V. The formation of methyl derivatives of 1 : 3-naphthylenediamine from the three tolylacetonitriles." By Ernest Francis Joseph Atkinson and Jocelyn Field Thorpe. (Trans., 1907, 1687.)

In order to throw some light on the colour change which ensues when ethyl β-imino-α-cyano-γ-phenylbutyrate is transformed into the sulphate of ethyl 1 : 3-naphthylenediamine-2-carboxylate by the action of concentrated sulphuric acid, the three methyl derivatives of this ethyl salt, containing the methyl group in the benzene nucleus, have been prepared and investigated. These three isomeric forms of ethyl β-imino-α-cyano-γ-tolylbutyrate :



pass on treatment with cold concentrated sulphuric acid into the corresponding methyl derivatives of ethyl 1 : 3-naphthylenediamine-2-carboxylate :



These ethyl salts on hydrolysis yield the corresponding carboxylic acids, which readily evolve carbon dioxide and pass into 1-methyl-5 : 7-naphthylenediamine, 2-methyl-5 : 7-naphthylenediamine, and 2-methyl-6 : 8-naphthylenediamine respectively.

Whereas the transformation of the meta-compound into the naphthalene ring at −5° is, like the other cases investigated previously, practically quantitative, the yield of the naphthalene derivative from the ortho- and para-compounds is scarcely 10 per cent. of the theoretical, the main product of each reaction being a phenolic base which is characterised by giving an intense colour with concentrated sulphuric acid.

The malachite-green solutions which were formed at the ordinary temperature, but not at − 5° in the reactions previously investigated, are therefore probably due to the formation of similar phenolic bases, since the naphthalene derivatives formed in the reactions do not themselves give colours with sulphuric acid. The following are the colour reactions of the three isomeric ethyl salts named towards concentrated sulphuric acid at the ordinary temperature.

Ethyl *β*-imino-*α*-cyano-*γ*-*o*-tolylbutyrate dissolves, forming an intense red-brown solution, which on dilution becomes first olive-green and finally yellow.

Ethyl *β*-imino-*α*-cyano-*γ*-*m*-tolylbutyrate forms a cherry-red solution, which becomes colourless on dilution.

Ethyl *β*-imino-*α*-cyano-*γ* *p*-tolylbutyrate dissolves, forming an intense magenta-red solution, which on dilution becomes first violet, then blue, then green, and finally yellow.

No colour is formed in the case of the meta-derivative at − 5°, but lowering of the temperature has no effect on the colour formation of the ortho- and para-compounds.

187. "The chemical action of radium emanation. Part II. On solutions containing copper and lead, and on water." By Alexander Thomas Cameron and Sir William Ramsay, K.C.B. (Trans., 1907, 1593.)

Radium emanation, as is known, yields helium when allowed to stand alone or mixed with oxygen and hydrogen gases. When dissolved in water, the gaseous product is neon, containing a trace of helium, and in presence of copper nitrate, the product is argon, containing no recognisable trace of helium. The copper solution, after the emanation has decayed in contact with it, is found to contain a trace of lithium; at the same time, the weight of the residue, which consists mainly of sodium salts, is considerably increased. The experiments were carried out in glass bulbs.

The authors suggest as a hypothesis: (1) that helium and the *α*-particle are not identical; (2) that helium results from the "degradation" of the large molecule of emanation by its bombardment with *α*-particles; (3) that this "degradation," when the emanation is alone or mixed with oxygen and hydrogen, results in the lowest member of the series to which the emanation undoubtedly belongs, namely, helium; (4) that if particles of greater mass than hydrogen or oxygen are associated with the emanation, namely, liquid water, then the "degradation" is less complete, and neon is produced; (5) that when molecules of still greater weight and complexity are present, as is the case when the emanation is dissolved in a solution of a copper salt, the product of "degradation" of the emanation is argon. They are also inclined to believe that the copper also is involved in this process of degradation, being reduced to the lowest member of its series, namely, lithium, and they suspect that, at the same time, sodium is produced in much greater quantity than lithium. Experiments on the gases evolved from thorium nitrate show that carbon dioxide is one of the products; this might be interpreted by the same hypothesis, in supposing carbon to be formed by the degradation of thorium, the highest member of the carbon series.

188. "Indican. Part I." By Arthur George Perkin and William Popplewell Bloxam. (Trans., 1907, 1715.)

Indican, $C_{14}H_{17}O_6N,3H_2O$, crystallises from a mixture of benzene and alcohol in anhydrous prisms, m. p. 176—178°, and in this form can be readily recrystallised from absolute alcohol. On hydrolysis with dilute acids in the presence of isatin, a quantitative yield of indirubin is obtained, as predicted by Beyerinck (*Proc. K. Akad. Wetensch. Amsterdam*, 1899, **2**, 120), but a theoretical yield of indigotin has not as yet been produced from it by a combination of hydrolysis and oxidation. When indican is digested with boiling dilute acid in absence of air, a complex reaction occurs, a trace of indole being formed together with dextrose (compare Hazewinkel, *Proc. K. Akad. Wetensch. Amsterdam*, 1900, **2**, 512) and brown, amorphous substances. The main constituent of the latter, for which the name *indoxyl-brown* is suggested, has a similar composition and closely resembles the chief constituent of indigo-brown (*Trans.*, 1907, **91**, 295), with which it is, no doubt, closely allied, but, on the other hand, it is more soluble in alcohol, and differs from it in certain minor respects. It has been found possible to isolate as much as 30 grams of crystalline indican from 1 kilogram of the leaves of the *Indigofera Sumatrana*.

189. "The occurrence of quercitol (quercite) in the leaves of Chamaerops humilis." By Hugo Müller.

This paper gives a short account of the occurrence of quercitol (quercite) in the leaves of *Chamaerops humilis*, the only species of the palm family indigenous in Europe.

These leaves in the dry state yield as much as 1·35 per cent. of this substance, and, as it can be obtained from them by a very simple process, may form a suitable material for its preparation.

This quercite is the dextro-modification and is identical with that obtained from acorns.

190. "Cocositol (cocosite), a constituent of the leaves of 'Cocos nucifera' and 'Cocos plumosa.'" By Hugo Müller.

Cocosite, isomeric with inosite, is contained in the leaves of *Cocos plumosa* and *Cocos nucifera* and also in the so-called milk of the cocoanut. In general chemical character, it resembles inosite and shows the characteristic rhodizonic acid reaction, but differs very widely in its physical properties, such as crystalline form, melting point, and solubility in water.

A *hexa-acetate*, a *nitrate*, and *sulphonic acids* have been obtained and examined.

Cocosite still more closely resembles the quercenin found by Delachanel and Vincent in the acorn and also the scyllit of Staedeler and Frerichs, recently re-investigated by J. Müller. It seems highly probable that these three substances are identical.

191. "Inositol (inosite)." By Hugo Müller.

The difficulty of procuring a somewhat larger supply of material for the fuller investigation of cocosite suggested a previous study of the behaviour of the isomeric inosite, when submitted to the reactions contemplated for this purpose, as the results thus obtained would serve as a guide and indirectly effect an economy in the use of cocosite.

A considerable quantity of inosite, which had been prepared from cochineal, furnished the material for this investigation.

The behaviour of inosite hexa-acetate, when submitted to the action of a saturated solution of hydrogen bromide in glacial acetic acid in the manner described by W. H. Perkin, jun., and J. L. Simonsen, has been investigated and also the reaction of hydrogen peroxide in conjunction with ferrous sulphate on inosite according to the methods devised by Fenton.

Monobromoinosite penta-acetate, two isomeric forms of *dibromoinosite tetra-acetate*, and also *inosite dibromohydrin* have been fully examined.

On treating the monobromo-penta-acetate with zinc dust, it loses its bromine along with one molecule of acetic acid.

If, on the other hand, the dibromoinosite tetra-acetates are treated in the same manner, phenol and acetic acid are the only products.

The treatment of inosite by Fenton's method with hydrogen peroxide yields, with a transitory dark violet-blue coloration, besides some oxalic acid, a substance which has not yet been obtained in a definite form, but from which the barium rhodizonate and potassium-croconate have been prepared.

October 18th, 1907. Extra Meeting, Sir W. Ramsay, K.C.B., F.R.S., President, in the Chair. This meeting was held in the Theatre of the Royal Institution, by kind permission of the Managers.

The President, in opening the proceedings, said: Professor Fischer needs no introduction to you; but I may remind you that he was asked to give the Faraday Lecture in 1895. At that time his health precluded him from coming to England, and we have now to congratulate him that his health has greatly recovered, and ourselves especially on his having come among us to-night to deliver the Faraday Lecture. I shall not, however, take up any more time, but at once ask Professor Fischer to deliver his address.

Professor Fischer, speaking in German, then delivered the Faraday Lecture, of which the following account is an abstract: *

"Synthetical chemistry in its relation to biology."

We know that in nature the construction of organic matter begins in the leaves of plants with the conversion of carbon dioxide into sugar, from which many physiologists suppose the complex substances contained in the living cell are formed by further changes in which nitrogen, sulphur, and phosphorus take part.

Nothing definite, however, is known even of the assimilation of carbon dioxide, and although it is now possible to effect the complete synthesis of sugar at temperatures such as prevail in the living plant, our laboratory methods fall far short of the efficient manner in which this work is accomplished in nature. One peculiarity of the natural change is the asymmetric character of the synthesis, and I showed some time ago that it is possible to give a fairly satisfactory explanation of this. It is only necessary to assume that the condensation is preceded by the formation of an additive compound of formaldehyde with some optically active constituent of the chlorophyll granules. I am inclined to think that this compound with carbon dioxide undergoes decomposition into oxygen and a reduction product, probably a derivative of formaldehyde; the condensation to sugar takes place either in the original asymmetric complex or in one produced

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* Full report, Trans., 1907, p. 1749.

from it by a secondary change involving the separation of the formaldehyde and its re-association in some other manner.

The formation of fats in plant and animal tissue is no less complicated a phenomenon. It is certain that carbohydrates are the chief source of supply. We know next to nothing, however, of the actual course of this remarkable synthesis; it is easy to imagine that glycerol may be formed by the hydrolysis of glucose, and that three molecules of glucose may give rise to an acid containing eighteen carbon atoms. But the process involved in the conversion of sugar which is rich in oxygen into fatty acids containing little oxygen remains wrapped in mystery. I imagine that this change, like that which attends alcoholic fermentation, is effected by a re-arrangement of oxygen atoms within the molecule, and that it involves the elimination of carbon dioxide.

The problems afforded by the fats are simple, however, in comparison with those connected with the carbohydrates.

Up to the present time only the monosaccharides have been studied satisfactorily from the point of view of their spatial structure. The dogma which at one time prevailed that Nature produces only carbohydrates with six atoms of carbon was upset by Kiliani's discovery that arabinose contains but five atoms of carbon. Since then the group of the monosaccharides has been so extended by synthetic means that sugars of all types are now known, the group including besides the seven compounds which occur naturally no less than forty-five synthesised products.

The growth of our knowledge of the monosaccharides has proved in many ways to be of importance in connexion with biological inquiry, especially in enabling us to penetrate the mystery of enzyme action somewhat further.

On contrasting the effects which emulsin and the enzymes in yeast produce on the various glucosides prepared by synthetic methods, I was led to conclude not only that there was a difference between the two series of optical antipodes similar to that discovered by Pasteur in the course of his studies of moulds but that very slight changes in configuration were sufficient to inhibit the action of enzymes entirely. I was led by these observations to apply the simile of *lock* and *key* as an expression of the close inter-relationship in configuration which obtains between the enzyme and the substance which it attacks.

The experience gained with the glucosides became of service in studying the polysaccharides and, as the result of my investigations, I was able to formulate a rule of general biological significance, namely, that the alcoholic fermentation of a polysaccharide is necessarily preceded by its hydrolysis by some particular enzyme. It was shown, especially in the case of the invertase of *Monilia Candida*, that it is not essential that the enzyme should even be soluble in water.

Unfortunately but few successful syntheses of polysaccharides have been effected. Musculus obtained dextrin-like products from grape sugar by treating it with mineral acids; and I have shown that a disaccharide, *iso*maltose, may be produced in this way.

The carbohydrate group is that in which use was first made of enzymes as synthetic agents. Croft Hill has the great merit of having been the first to demonstrate the reversibility of enzyme action, and an important extension of Croft Hill's discovery is afforded by E. F. Armstrong's observation that the action of emulsin is different from that of the enzymes of yeast, the condensation of glucose taking place in such a way that a disaccharide which appears to be maltose is formed together with other complex products. Such syntheses, however, cannot take the place of purely chemical methods, as these latter are so much more under our control, and can be varied in so many ways, that we are in the position to produce materials which it is quite impossible for the organised world to furnish.

This contention is applicable to the proteins even more than it is to the carbohydrates: as they are among the most complex substances produced in the living world and are concerned in all the vital activities of the cell, a complete comprehension of their nature must obviously precede the full development of biological chemistry.

Of the numerous attempts to unravel the constitution of the proteins by analytical means, the only method which has given useful results hitherto is that of hydrolysis. Hydrolysis can be effected by acids or by alkalis and also by digestive enzymes; the products, it is well known, besides ammonia, are albumoses, peptones, and ultimately amino-acids. The complete synthesis of the active amino-acids which are obtained from natural sources was first accomplished by the method I introduced based upon the use of the acyl derivatives. The method has been applied with success to the majority of the synthetic products; its extension to the remaining cases, proline, lysine, tryptophane, and cystine, is not likely to be attended with any difficulties.

As the amino-acids are formed from the proteins, not only when these are subjected to the action of hot acids and alkalis, but also at moderate temperatures by the agency of the digestive enzymes, they are to be regarded as the true foundation stones of protein molecules and it has been found to be possible, by a process the reverse of hydrolysis, to associate amino-acids in such a manner that substances are produced which, in the case of the simpler terms, closely resemble peptones, whilst the more complex resemble proteins.

I have termed these synthetic products *polypeptides*, in view of their relationship to the peptones and to facilitate systematic treatment of the group on the lines of the carbohydrates; more than one hundred of these artificial polypeptides have already been synthesised.

By making use of new methods based on the study of the polypeptides, it has been possible during the last two years to isolate and detect with certainty quite a number of dipeptides among the decomposition products of the proteins. In conjunction with Abderhalden, I have succeeded in separating glycyl-*d*-alanine, *d*-alanyl-*l*-leucine, and *l*-leucyl-*d*-glutamic acid from silk fibroin, elastin, and gliadin respectively. We have definitely proved the existence of dipeptides of glycine with *l*-leucine and *l*-tyrosine in the form of anhydrides, and our work has made it probable that other combinations exist, for example, that of glycine with valine.

A tetrapeptide of fairly definite composition has been isolated by Abderhalden and myself from silk fibroin and, although its homogeneity is not yet quite established, it is certainly in great part a combination derived from two glycine molecules with one of *d*-alanine and one of *l*-tyrosine. The substance is of special interest on account of its close resemblance to the albumoses. Moreover, *l*-leucyl-triglycyl-*l*-tyrosine prepared artificially has all the properties of the albumoses. These observations are of importance as casting doubt on the view which formerly prevailed that, being intermediate products between proteins and peptones, the albumoses are substances of considerable molecular complexity.

In presenting the Faraday Medal to Prof. Fischer at the conclusion of the lecture, the PRESIDENT said: Before I call on Sir Henry Roscoe, I have great pleasure, Prof. Fischer, in the name of the Chemical Society in handing over to you this medal as a testimony of our great regard for you as our foreign member and of our affection for you as a man.

Sir HENRY ROSCOE: Mr. President, Ladies and Gentlemen,—I have had the good fortune to hear many Faraday Lectures. I remember with pleasure the eloquence of Dumas; the charm of Wurtz, and the thought and beautiful diction of Helmholtz; but, Mr. President, I do not think that any of our Faraday Lectures has awakened greater interest than the one to which we have just listened; and this, not only because Prof. Emil Fischer is a master of his subject, and because he has laid before us work mainly accomplished by his own inventive brain and his own able hands, but also because the subject of the application of synthetical chemistry to biology which the lecturer has so ably brought before us is one which at the present moment is exceeded in interest and importance by no other branch of the science, not even—if I may be allowed, in the presence of the President, to say so—by that of radio-activity. Of the nature and character of the work which Prof. Emil Fischer has accomplished, the Fellows of the Chemical Society are good judges. When some years ago we learned that Emil Fischer had synthesised the sugars, all chemists were loud in their expressions of satisfaction and admiration. How much greater will those expressions be now when we learn what success has attended the apparently almost insoluble problem of the synthesis of the proteins.

If the one resembles the ascent of some unconquered Swiss peak, the other may be compared with the far greater feat of the attempt to reach the top of Mount Everest. But even supposing the last thousand feet of the mountain have proved to be too much for the strength of the mountaineer, yet the most important result has been achieved, for the route has been laid down and the directions given by which subsequent explorers may gain the summit. As Emil Fischer has already succeeded in this synthesis of the sugars, so he has pointed out the method by which he himself, as we all hope, or others following in his footsteps, will succeed in fully unravelling the constitution of those chemical mysteries, the proteins. By this grand work he has won for himself the admiration of us all—of all those who are interested in scientific discovery; and for bringing this subject before us in so able a manner I have the honour and pleasure of proposing a vote of thanks.

Sir James Dewar: Mr. President, Ladies and Gentlemen,—I am exceedingly grateful to the Council for the honour which they have done me and more especially the Institution by asking me to second the admirable and eloquent vote of thanks which Sir Henry Roscoe has proposed. I assume that this has been conferred upon me as a tribute to the great man whom we have come here, Sir, to honour. For some thirty-four years, Faraday held the Chair, which I have had the honour of holding, I am sorry to say, for now nearly thirty years. I cannot help thinking that the last portion of your address, in particular where you deal with the aims and method of the investigator, as well as the part that has been put so prominently before us by Sir Henry Roscoe, would have specially appealed to Faraday. Sometimes we have too great brilliancy in investigation. We have been told that the foundations of our science are being shaken, that we are living in an age in which the chemistry of the past will disappear, and that we shall have to reconstruct it on an entirely new basis. Now, Sir, I think you have conferred, by your work, the greatest honour upon the chemistry of the past. You have worked along the beaten lines of scientific investigation founded by Liebig, followed by Hofmann, Wurtz, Kekulé, and Baeyer, and have shown that, by following these ancient tracks, you can now assimilate new ground in a manner which these chemists would never have believed possible. In that way, Sir, you have consolidated the science of chemistry. However much, as Sir Henry Roscoe pointed out, we may wonder and admire radium, still we cannot but admit that the chemistry of carbon is the most extraordinary of that of all the elementary bodies, and that you, Sir, have done more than any man living to convince us of the possibility of yet further achievements in organic synthesis. What you have done would, I think, have appealed very much to Faraday, from the fact that you have worked in this magnificent, steady, undespairing, but yet successful way. There is a very admirable story of your great countryman, Luther, which represents the spirit of Faraday. Some very inquisitive person was anxious to obtain from Luther his opinion as to whether certain passages in the Scriptures were canonical or apocryphal, and Luther replied that the saints who particularly appealed to him were those of whom no marvellous stories had been recorded; who lived their lives without pretence like other people, and who did not desire to make themselves notorious. I am perfectly certain that was the mind of Faraday, and that is the mind of Emil Fischer. The man is sometimes greater than his work, and we admire you, Sir, not only for your work, but as a man. May I say that in coming here you have done a double honour to the Royal Institution. Perhaps you may be unaware of it. It has sometimes been said that the greatest discovery that Davy ever made was Faraday. You can hardly dissociate the one from the other. Now you have selected spontaneously this date for the first lecture of the season, although the Royal Institution really does not open until Christmas, and to-morrow is the centenary of the discovery of the alkali metals by Sir Humphry Davy. I do not know whether you knew this fact—but you have come here, and you have adorned both the names of Faraday and Davy by lecturing in the same room, which is practically in the same condition and at the same table where they have so often discoursed. I have to convey to you the hearty thanks of all the members of the Institution. We wish you long life to continue your great labours to adorn science, not only Germanic science, but the science of the world.

The CHAIRMAN having put the vote to the meeting, it was carried with acclamation.

Professor FISCHER, speaking in English, said: Mr. President, Ladies and Gentlemen,—I owe you my sincere thanks for the kind recognition which you have been so good as to extend to my modest endeavours. I have felt exceedingly honoured in having received this invitation of the Chemical Society to come here to deliver the Faraday Lecture, and to pay homage to the great discoverer who so often on this very spot announced the results of his wonderful researches. But it affords me a keener pleasure to recall on this occasion the constant friendly intercourse which has existed during many generations between the English and the German men of science, and which has led to much happy exchange of scientific thought.

Thursday, October 24th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. J. V. J. Hayman, J. W. Shepherd, and C. H. Warner were formally admitted Fellows of the Society.

The PRESIDENT reminded Fellows of the loss which the Society had sustained since the previous meeting by the death of Sir William Henry Perkin, Dr. John Clark, Dr. August Dupré, and Mr. F. J. M. Page.

It was announced, also, that on the occasion of the Centenary Celebration of the Geological Society, the following address was presented :

In the name of the Chemical Society we welcome the present opportunity of offering our warmest congratulations to the President, Council, and Fellows of the Geological Society of London on the occasion of its Centenary Celebration.

It is impossible to overestimate the value of the great work which your Society has accomplished during the past hundred years, both in laying the solid foundations of a new science and in helping to raise on these foundations the stately edifice of Modern Geology.

The connexion between Geology and Chemistry has always been, and must ever remain, a very intimate one, and the early history of your Society shows that Chemists a hundred years ago fully recognised that their special branch of Natural Knowledge was destined to play an important part in elucidating those changes in the structure of the earth which fall within the special province of the Geologist.

This association between the two Societies is brought into further prominence by the fact that amongst the thirteen original founders of your Society, we find the names of no less than five celebrated chemists, viz., Arthur Aikin, William Allen, Humphry Davy, W. H. Pepys, and Richard Phillips ; whilst within the first few years of your corporate existence the roll of your Fellows includes the names of Thomas Thomson, William T. Brande, Edward Turner, James Hall,

W. H. Wollaston, J. F. Daniell, Charles G. Daubeny, and Alexander J. Marcet.

The advances in Modern Petrology, a subsection of Geology which may be said to have been initiated by your Society, have demanded a still closer union between our respective branches of Science, and in the new ideas introduced within the last decade by the discovery of radio-activity we see further indications that Physical Chemistry in the near future must influence many of the fundamental doctrines bearing on the age of the earth, and on the various changes which the earth has undergone within the period embraced by Geology.

Signed, on behalf of the Chemical Society,

WILLIAM RAMSAY, *President.*
ALEXANDER SCOTT, *Treasurer.*
M. O. FORSTER, } *Honorary*
ARTHUR W. CROSSLEY, } *Secretaries.*
HORACE T. BROWN, *Foreign Secretary.*

Certificates were read for the first time in favour of Messrs.:

John Forbes Bell, Craigmillar, Edinburgh.
Edward Joseph Day, M.D., M.R.C.S., L.S.A., Dorchester, Dorset.
Frederick Harold Dupré, Mount Edgcumbe, Sutton, Surrey.
Percy Vivian Dupré, A.C.G.I., Mount Edgcumbe, Sutton, Surrey.
Francis Bridger Dutton, Birch Hall, Windlesham, Surrey.
Thomas Rigby Greenough, B.A., Beechwood, Leigh.
William Doge Hutchinson, B.A., Lythmore, Tennyson Rd., Harpenden.
Harry Ingham, M.Sc., 26, Hamilton Street, Bury.
Herbert Marsden, B.Sc., Bramford, Ipswich.
Herbert Frederick Sankey Marshall, High Street, Burwell.
Gerald Hargrave Martin, Delce, Park Road, Wallington.
John Edward Langford Moore, Walton Cottage, Loughboro' Park, S.W.
Charles Samuel Mummery, Christ's Hospital, West Horsham.
Harold Ramsay Stobie, Clovelly, Craighall Gardens, Edinburgh.
Frederick Thomas, B.Sc., 29, Fairhaven Rd., St. Annes-on-the-Sea.
Harold Munkman Timpany, M.Sc., St. Winifrede's Gardens, Shrewsbury.
George Arthur Watson, A.R.C.S.I., 7, Roseneath Villas, Cork.
Edward Wheeler, A.C.G.I., 113, Highbury Quadrant, N.
Robert Whymper, A.C.G.I., St. Clare, St. Mary's Rd., Ditton Hill.
Percy Williams, B.Sc., c/o The Wilhelmina Co., Pontianak, Dutch West Borneo.
William John Wilson, A.C.G.I., 28, Windmill Street, Gravesend.

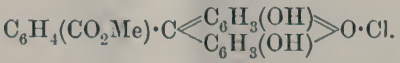
Of the following papers, those marked * were read :—

***192. "The constitution of phenol- and quinol-phthalein salts: a contribution to the quinonoid theory of colour." By Arthur George Green and Percy Edgar King.**

Prof. Green gave an account of the following investigation which has been described in *Ber.*, 1906, **39**, 2365; 1907, **40**, 3724.

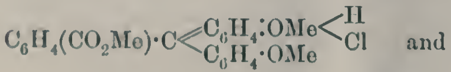
Green and A. G. Perkin have adduced evidence as to the constitution of phenol- and quinol-phthalein salts which cannot be reconciled with the indicator theory of Ostwald. On the other hand, the view that the appearance of colour during salt formation is due to a change of type from the lactone or triphenylcarbinol form to the quinonoid form has hitherto not met with general acceptance, largely owing to the failure of repeated attempts to obtain coloured carboxylic esters of these phthaleins.

The authors have now succeeded in preparing the coloured carboxylic esters, not only of the phthaleins themselves, but also of their mono- and di-methyl ethers. These esters, which are orange to red, are extremely unstable, being readily saponified, not only by weak acids or alkalis, but even by water. They form with acids, oxonium salts which are of a deeper colour than the free esters. Whilst the esters of phenolphthalein, $C_6H_4(CO_2Me)\cdot C<\begin{array}{l}C_6H_4:O\\C_6H_4\cdot OH\end{array}$, and of monomethylphenolphthalein, $C_6H_4(CO_2Me)\cdot C<\begin{array}{l}C_6H_4:O\\C_6H_4\cdot OMe\end{array}$, were obtained in the free state and are more stable than their chlorides, the esters of quinolphthalein and of monomethylquinolphthalein could only be isolated in the form of the oxonium salts, thus:



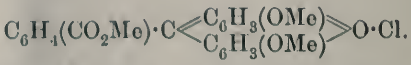
$$C_6H_4(CO_2Me)\cdot C<\begin{array}{l}C_6H_3(OH)\\C_6H_3(OH)\end{array}>O\cdot Cl.$$

The esters of dimethylphenolphthalein and of dimethylquinolphthalein (trimethyl derivatives) are only capable of existence as salts, a fact which agrees well with the representation of the chlorides as



$$C_6H_4(CO_2Me)\cdot C<\begin{array}{l}C_6H_4:OMe<\begin{array}{l}H\\Cl\end{array}\\C_6H_4\cdot OMe\end{array}$$

and



$$C_6H_4(CO_2Me)\cdot C<\begin{array}{l}C_6H_3(OMe)\\C_6H_3(OMe)\end{array}>O\cdot Cl.$$

The monomethyl esters of both phthaleins are soluble in alkalis, giving strongly coloured solutions similar to those of the phthaleins themselves, but not decolorised by an excess of alkali. On the other hand, the isomeric lactone ethers are colourless and do not give coloured salts.

These facts disclose an exact parallelism between the esters and salts of these phthaleins and those of fluorescein, and place the quinonoid structure of these substances almost beyond question.

DISCUSSION.

Dr. HEWITT remarked that in certain cases it was very difficult to assign a quinonoid constitution to coloured compounds. He had himself found that the colourless lactone of 2 : 4 : 2′ : 4′-tetrahydroxydiphenylacetic acid dissolves in alkalis with a colour extremely like that produced by phenolphthalein, but the colour is discharged on breaking the lactone ring. He had not, however, been able to devise any plausible quinonoid formula for the salts of the lactone.

Prof. GREEN, replying to Mr. Baly, said that the assumption of an oxonium hydrate group in the alkali salts of phenolphthalein was not a necessary deduction from his experiments, but was only advanced in order to give a clearer expression to the analogy in behaviour between these salts and those of quinolphthalein, the latter of which must contain an oxonium group.

Mr. Baly's statement that a quinonoid compound containing oxonium hydrate groupings would be colourless did not rest on any experimental evidence known to him.

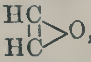
The conclusion that the esters described were quinonoid compounds was in no way deduced from their colour, but was a necessary consequence of the experimental facts adduced in the paper, and depended especially on the proof that the methyl group was attached to the carbonyl and the chlorine atom in the ester chlorides to oxygen. These facts, especially in the case of the trimethyl ether of quinolphthalein, scarcely admitted of any other interpretation than that given.

*193. "Ketene." By Norman Thomas Mortimer Wilsmore.

The gaseous substance produced by the action of a hot platinum wire on acetic anhydride, which was discovered by Dr. A. W. Stewart and the author (*Nature*, 1907, 75, 510), has been further examined. As a mean result, it was found that, on exploding one volume of the gas with excess of oxygen, there was a contraction of 1·09 volumes, and that the residual gas contained 1·97 volumes of carbon dioxide, whilst 2·08 volumes of oxygen had disappeared. The corresponding numbers for a gas having the formula C_2H_2O would be 1 : 1 : 2 : 2. A mean value for the density gave a molecular weight of 41·4, instead of 42. The gas has, however, not yet been obtained entirely free from acetylene and higher hydrocarbons. Its marked tendency to condense slowly, on standing, to a brown liquid is one of the chief difficulties in the way of its purification.

The substance combines directly with aniline to form acetanilide, with *o*-toluidine to form aceto-*o*-toluidide, with anhydrous liquid ammonia to form acetamide, and with ethyl and amyl alcohols to form the corresponding acetic esters. It also reacts vigorously with bromine, forming bromoacetyl bromide. As no by-products appear to be formed in these reactions, it may be inferred that the substance is a new anhydride of acetic acid, having the formula $CH_2{:}CO$ or $CH{:}C{\cdot}OH$, and, further, that it is the lowest member of the ketene series. With water, *ketene* gives chiefly acetic acid, but an aldehyde, probably glycollaldehyde, is formed at the same time. Ketene is also produced when an arc is made to burn under the surface of liquid acetic anhydride.

DISCUSSION.

The PRESIDENT suggested that a third possible formula for ketene would be  $\begin{matrix}HC\\ \| \\ HC\end{matrix}\!\!>\!O$, a substance having the same relation to acetylene as ethylene oxide has to ethylene. Such a compound might lend itself easily to polymerisation.

*194. "Derivatives of the multiple ketene group."

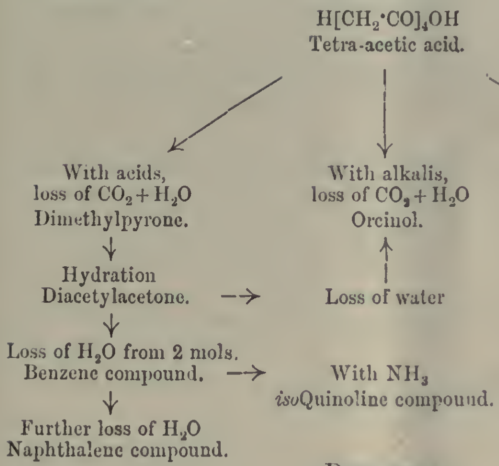
By John Norman Collie.

The group $\cdot CH_2 \cdot CO \cdot$ (which the author proposes to call the "*ketide*" group) can be made to yield by means of the simplest reactions a very large number of interesting compounds, all belonging to classes which are largely represented amongst the compounds obtained from plants.

Illustrations of this were given from the various published papers of the author. It was shown how by uniting more than one of these groups as in ethyl acetoacetate, $H[CH_2 \cdot CO]_2OH$, or in dehydracetic acid, $H[CH_2 \cdot CO]_4OH$, "*polyketides*" are obtained, and from these by means of the simplest reactions, such as hydration, dehydration, oxidation, reduction, loss of carbon dioxide, or action of ammonia, complicated polyketide derivatives result. These are found to represent many of the various types of compounds found in plants.

This can be partly illustrated as follows :

$H(CH_2{\cdot}CO)OH$	$H[CH_2{\cdot}CO]_2OH$	$H[CH_2{\cdot}CO]_4OH$
Acetic acid.	Diacetic acid.	Tetra-acetic acid.



DISCUSSION.

Dr. M. O. FORSTER inquired what compounds, exactly, were to be classified as polyketides. The name naturally invited comparison with the words polymethylene and polypeptide, the significance of which was perfectly clear, and from that standpoint a polyketide would be a substance built up of the complex, $[{\cdot}CH_2{\cdot}CO{\cdot}]_x$, with the necessary terminal groups or atoms. The application of the word in Prof. Collie's paper, however, was much more comprehensive, appearing to embrace such heterogeneous types as lactones, pyrone derivatives, benzenoid compounds, and substituted pyridines, and the speaker foresaw considerable danger in launching an entirely novel expression on chemical nomenclature without defining its scope more precisely.

*195. "Production of orcinol compounds by the action of heat on the sodium salt of ethyl acetoacetate." By John Norman Collie and Edwin Rodney Chrystall.

When ethyl acetoacetate (78 grams) is mixed with sufficient sodium ethoxide (4·6 grams of sodium in 50 c.c. of ethyl alcohol) to convert about one-third of it into the sodium salt and the mixture heated, ethyl acetate, alcohol, and ethyl acetoacetate distil. On treating the viscous residue in the flask with hydrochloric acid, a crystalline compound separates, which is best purified by recrystallisation from benzene (yield about 7·8 grams). It has the composition $C_{16}H_{16}O_6$ and melts at 169°:

$$4C_6H_{10}O_3 = C_{16}H_{16}O_6 + CH_3{\cdot}CO_2Et + 2EtOH + 2H_2O.$$

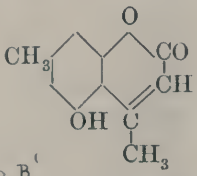
The new compound is soluble in aqueous sodium hydroxide with a deep yellow colour, but the colour changes to pale yellow on warming; acids precipitate from this solution an orange compound of high molecular weight, and alcohol is found in the residue. With sodium hydroxide and chloroform, it gives the orcinol reaction. With bromine, a compound of formula $C_{16}H_{15}O_6Br_3$, melting at 182·5°, is produced.

When warmed with 90 per cent. sulphuric acid to about 130—140°, carbon dioxide is evolved, together with alcohol and acetic acid, leaving a compound of formula $C_{11}H_{10}O_3$ melting at 250°:

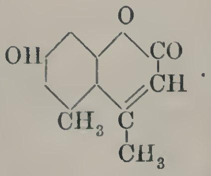
$$C_{16}H_{16}O_6 + 2H_2O = C_{11}H_{10}O_3 + CO_2 + EtOH + C_2H_4O_2.$$

This compound is identical with a substance prepared by von Pechmann and Cohen (*Ber.*, 1884, **17**, 2188) from orcinol and ethyl acetoacetate.

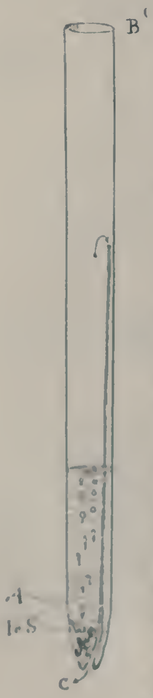
Its composition is either:



or



The *monomethyl ether* (m. p. 146°) and the *monoacetyl* derivative were prepared (m. p. 198°).



196. "A simple gas generator for analytical operations." By James McConnell Sanders.

The simple appliance described below has been found to be a convenient and practical substitute for the so-called "constant supply" apparatus of the "Kipp" type. It consists of a glass tube open at one end and having a fine, almost capillary, tube fused into the other end, as shown in the figure.

The apparatus is charged, for example, for the preparation of hydrogen sulphide by dropping one or two small fragments of ferrous sulphide into the tube so that they lodge in the annular space (*A*), a few drops of dilute sulphuric acid are then allowed to run into the tube, and the mouth (*B*) closed with the forefinger. The apparatus may then be introduced into a test-tube or beaker and used as an agitator, the gas escaping by way of the fine interior tube and the orifice (*C*).

For quantitative work, a larger apparatus is used and the mouth closed with a cork. For the preparation of a gas which requires the application of a gentle heat, the apparatus is allowed to touch the bottom of the test-tube while immersed in the liquid contents of the latter, and heat is applied to the test-tube itself.

After use, the generation of gas is instantly stopped by directing a stream of water from a wash-bottle into the interior, the outside is washed in the same manner, and the apparatus is then ready for use in a subsequent operation. The appliance has been in constant use in the Mexican Customs laboratories for the last five months, and in no case has it been found that the small inner tube showed any tendency to become clogged with precipitate.

197. "Some double ferrocyanides of calcium, potassium, and ammonium." By James Campbell Brown.

The conditions of preparation and the properties of calcium potassium ferrocyanide and calcium ammonium ferrocyanide were explained. These salts have been analysed and their solubilities determined. The calcium potassium ammonium ferrocyanides resulting from the mixture of varying proportions of calcium chloride, potassium ferrocyanide, and ammonium chloride were described, and the conditions for the use of ammonium chloride and potassium ferrocyanide as a qualitative test for calcium were given.

198. "Determination of halogen in organic substances." By James Moir.

The new method described last year by the author (*Proc.*, 1906, **22**, 261) has been improved by adopting the Volhard method of back-titration with standard thiocyanate.

The contents of the crucible after heating are dissolved and treated with a crystal of bisulphite to reduce manganate. A measured quantity of standard silver solution is added and the mixture is then acidified with nitric acid, heated to 70°, filtered through a Buchner funnel, using hardened paper, and the residue on the filter is extracted with hot dilute nitric acid. The filtrate is then cooled to 40° and titrated with standard thiocyanate and iron alum.

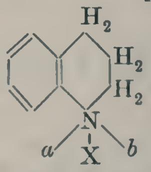
Each c.c. of $N/10$ silver solution, by difference, = 0·0080 gram of bromine.

199. "Racemisation by alkali as applied to the resolution of *r*-mandelic acid into its optically active isomerides." By Alex. McKenzie and Hermann August Müller.

It was shown that, as a product of the fractional saponification of *l*-menthyl *r*-mandelate in ethyl-alcoholic solution, either a dextrorotatory or a lævorotatory mandelic acid mixture may be obtained from the same weight of ester and using the same weight of alkali. The normal action is the formation of a dextrorotatory potassium salt; the formation of a lævorotatory potassium salt under the conditions quoted is abnormal.

Various methods of effecting the changes: (1) *r*-mandelic acid → *r*-mandelic acid and *l*-mandelic acid and (2) *r*-mandelic acid → *r*-mandelic acid and *d*-mandelic acid were indicated.

200. "The optical activity of cyclic ammonium compounds." By Frank Buckney and Humphrey Owen Jones.

Although it has been shown in a large number of cases that compounds of the type NabcdX can give rise to optical activity due to the asymmetric nitrogen atom, yet there is no well established case of activity when the nitrogen atom forms part of a ring. It was stated previously (*Trans.*, 1903, **83**, 1405) that substituted pyridinium compounds, quinolinium compounds, and tetrahydroquinolinium compounds of the type 

are all devoid of a plane of symmetry and should be capable of giving rise to optical activity. Several compounds were then examined, but no evidence of activity was obtained.

The following fourteen compounds have now been examined: 1-methyl-α-picolinium-*d*-camphorsulphonate and *d*-bromocamphorsulphonate, methyl- and benzyl-quinolinium-*d*-camphorsulphonates, methylkairolinium-1-acetate-*d*-camphorsulphonate and *d*-bromocamphorsulphonate, 1-methyl-1-ethyltetrahydroquinolinium-*d*-camphorsulphonate and *d*-bromocamphorsulphonate, 1-benzyl-1-ethyltetrahydroquinolinium-*d*-camphorsulphonate, benzylkairolinium-*d*-camphorsulphonate, *d*-bromocamphorsulphonate and tartrate, *n*-propylkairolinium-*d*-bromocamphorsulphonate, allylkairolinium-*d*-bromocamphorsulphonate. In the case of the last-mentioned compound only was there conclusive evidence of the existence of optical activity, the *l*-base *d*-acid salt was the less soluble and had $[M]_D = 198°$, and the *d*-base *d*-acid had $[M]_D = 343°$. The iodide was recovered in small quantity only, but was decidedly active.

201. "The action of phosphorus pentachloride on hydroxytrimethylsuccinic ester. 1 : 2-Dimethyl*cyclo*propane-1 : 2-dicarboxylic acid (1 : 2-dimethyltrimethylene-1 : 2-dicarboxylic acid)." By Herbert Henstock and Bertha E. Woolley.

The authors have examined the chief chemical and physical properties of 1 : 2-dimethyl*cyclo*propane-1 : 2-dicarboxylic acid (1 : 2-dimethyltrimethylene-1 : 2-dicarboxylic acid), the optical properties of its diethyl ester having been investigated for them by the late Sir William Perkin. The object of the work was to determine whether this constitution, which was assigned to the acid by Paolini (*Gazzetta*, 1900, **30**, ii, 497), is the correct one, since, if its saturated cyclic character were proved, an important difference is indicated in the behaviour of two so nearly allied substances as bromotrimethylsuccinic anhydride (which yields methylenedimethylsuccinic acid) and chlorotrimethylsuccinic ester when the hydrogen haloid is removed from the molecule. The authors' work confirms that of Paolini.

On the elimination of the hydrogen haloid from chlorotrimethylsuccinic ester, 1 : 2-dimethyl*cyclo*propane-1 : 2-dicarboxylic acid is formed.

202. "The condensation of acetaldehyde and its relation to the biochemical synthesis of fatty acids." By Henry Stanley Raper.

It has been suggested that the formation of fatty acids, in animals, from carbohydrates depends, firstly, on a break-down of the carbohydrate to yield, amongst other products, acetaldehyde, and, secondly, on the condensation of the acetaldehyde leading to the formation of the higher fatty acids. The object of this investigation was to determine whether acetaldehyde on condensation yields the straight-chain compounds which would be necessary for the production of the higher fatty acids, as previous observations on the condensation of aldehydes point to the formation of compounds with branched-chains.

This objection to the above hypothesis has been partly removed, for it has been found that β-hydroxybutyraldehyde, the first product of the condensation of acetaldehyde, on further condensation yields an aldehyde containing eight carbon atoms united in a straight-chain.

203. "The influence of solvents on the rotation of optically active compounds. Part X. Effect of the configuration and degree of saturation of the solvent." By Thomas Stewart Patterson, Andrew Henderson, and Frank Walter Fairlie.

Solutions of ethyl tartrate in ethyl fumarate, ethyl maleate, and ethyl succinate were examined as regards rotation. Fumaric and maleic esters were found to have much the same effect, which is greater than the effect of succinic ester. The results were discussed from the point of view of combination of solute and solvent.

204. "Para-toluidine monohydrate." By James Walker and Heather Henderson Beveridge.

p-Toluidine crystallises from water and from aqueous alcohol as a monohydrate which melts at about 41·5°, the melting point of the anhydrous base being 43·5°. The monohydrate effloresces in the air, but, on the other hand, the anhydrous base absorbs water from air saturated with moisture, and is converted into the monohydrate. In contact with liquid water, the anhydrous base is converted into the monohydrate at all temperatures up to the melting point of the latter. The pressure of water vapour over the monohydrate at the ordinary temperature is somewhat more than half that of liquid water.

205. "Hydrates of some quaternary bases." By David Cowan Crichton.

Solutions of tetraethylammonium hydroxide, tetrapropylammonium hydroxide, and trimethylsulphine hydroxide were prepared from the corresponding chlorides by means of potassium hydroxide (compare Walker and Johnston, *Trans.*, 1905, **87**, 955).

A *tetrahydrate* and a *hexahydrate* of tetraethylammonium hydroxide were described. When the tetrahydrate is made to lose water at the ordinary temperature, the base decomposes with formation of triethylamine, ethylene, and water.

A *heptahydrate* of tetrapropylammonium hydroxide was separated by cooling the aqueous solution in a freezing mixture. This hydrate melts when raised to the ordinary temperature.

Attempts to prepare a crystalline hydrate of trimethylsulphine hydroxide were unsuccessful.

206. "Two volumetric methods for the determination of chromium." By Arnold William Gregory and James McCallum.

The authors have modified the persulphate method for the estimation of chromium in iron and steel, with the object of obtaining accurate results in a minimum time.

In the presence of manganese, the permanganic acid, formed simultaneously with the chromic acid, is reduced, either by the addition of a little ammonium chloride or by means of hydrogen peroxide.

The chromic acid formed is titrated with ferrous sulphate solution of known strength.

A method of oxidising the chromium with sodium bismuthate was also described. It is found to give very satisfactory results.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Beadle, *Clayton.* Chapters on papermaking. Vol. II. Comprising answers to questions on papermaking set by the examiners to the City and Guilds of London Institute. Vol. III. Comprising a short practical treatise in which boiling, bleaching, loading, colouring, and similar questions are discussed. Vol. IV. Containing discussions upon water supplies and the management of the paper machine and its influence upon the qualities of papers. pp. vii + 174, viii + 134, vii + 156. London 1906—1907. (*Recd.* 17/10/7.)
From the Author.

Curtius, *Theodor.* Festschrift Theodor Curtius zum 25 jährigen Doktor-Jubiläum gewidmet. Arbeiten aus dem Chemischen Institut der Universität Heidelberg von *G.* **Bredig,** *A.* **Darapsky,** *E.* **Ebler,** *H.* **Franzen,** *P.* **Jannasch,** *A.* **Klages,** *E.* **Knoevenagel,** *E.* **Mohr,** *R.* **Stollé.** pp. xc + 245. [pp. 1—245 reprinted from *Verhandl. d. Naturhist.-Med. Vereins.* N.F. 1907, 9.] Heidelberg 1907. (*Recd.* 31/7/7.) From Geheimrat Professor Dr. Theodor Curtius.

Dibdin, *W. J.* Recent improvements in methods for the biological purification of sewage. 2nd edition. pp. 68. ill. London 1907. (*Recd.* 18/7/7.) From the Author.

Fischer, *Emil.* Untersuchungen in der Puringruppe (1882—1906). pp. viii + 608. Berlin 1907. (*Recd.* 30/9/7.) From the Author.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 9th, 1907.

Those Fellows who received grants in December, 1906, or whose grants allotted in December of previous years have not been closed, are reminded that reports must be in the hands of the Hon. Secretaries not later than Monday, December 2nd, next.

At the next Ordinary Meeting on **Thursday**, November **7th**, 1907, at **8.30** p.m., the following papers will be communicated:

"Gaseous nitrogen trioxide." By H. B. Baker and Mrs. M. Baker.

"The atomic weight of tellurium." By H. B. Baker and A. H. Bennett.

"The isomerism of the double sulphites of sodium and potassium." By M. H. Godby.

"Studies in the camphane series. Part XXIV. Camphoryldithiocarbamic acid and camphorylthiocarbimide." By M. O. Forster and T. Jackson.

"The vapour pressures of triethylamine, of 2:4:6-trimethylpyridine, and their mixtures with water." By R. T. Lattey.

"Liquid triethylamine." By R. T. Lattey.

"The action of hydrogen sulphide on solutions of sodium hyposulphite." By F. S. Sinnatt.

"The alkyl compounds of gold. Diethylauric bromide. Preliminary note." By W. J. Pope and C. S. Gibson.

"Note on the constitution of homoeriodictyol." By F. B. Power and F. Tutin.

"The interaction of methylene chloride and the sodium derivative of ethyl malonate." By F. Tutin.

"Preparation of aliphatic nitro-compounds by the interaction of the alkyl iodides and mercurous nitrite." By P. C. Rây and P. Neogi.

"Some mercury derivatives of camphor." By J. E. Marsh and R. de J. F. Struthers.

"Contribution to the chemistry of the terpenes. II. The oxidation of limonene with chromyl chloride." By G. G. Henderson.

"The synthesis of acridines and phenonaphthacridines: Tetra- and hexa-methylacridines: Dimethylphenonaphthacridines: Dixylylmethylenediamines." By A. Senier and A. Compton.

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Issued 16/11/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 331.

Thursday, November 7th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. P. C. Austin, C. Hollins, and L. G. Killby were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Edward de Barry Barnett, 40, Queensborough Terrace, Hyde Park, W.
Frederic William Caton, B.A., B.Sc., 6, King Street, Snow Hill, E.C.
George Hugh Crisp, B.A., 62, Gainsboro' Road, Crewe.
Claude Scott Fawcitt, Darlington, England ; and Shimoga S.M.Ry., India.

Of the following papers, those marked * were read :—

*207. "Gaseous nitrogen trioxide." By Herbert Brereton Baker and Muriel Baker.

The authors have found that liquid nitrogen trioxide can be converted into the gaseous state if it is dried completely. Seventeen determinations of the density of the gas have been made by Victor Meyer's method in very dry nitrogen. Several different preparations were used and the densities varied from 38 to 62. The density corresponding to the formula N_2O_3 is 38, and it is concluded that there is partial polymerisation to the double molecule N_4O_6. The analysis of the substance gave 63·12 per cent. of oxygen (mean of 5 experiments), the calculated value for the trioxide being 63·09. Determinations of the molecular weight by the cryoscopic method in dried benzene gave 83 and 83·2 for one sample and 95 for another. The liquid is green at the ordinary temperature, but becomes blue below $-2°$. It does not solidify at $-80°$, but in liquid air it solidifies to a mass of very dark blue crystals.

DISCUSSION.

Dr. VELEY asked if the authors had examined the effect of sunlight on nitrogen trioxide, as it appeared possible that the variations in composition and density of the several samples examined might be due to this cause.

The observation of the authors that nitrogen trioxide does not dissolve in water to form nitrous acid, as such, seemed of especial interest; although this acid was frequently represented as a reagent in chemical change, yet those who had worked on the subject had begun to realise that nitrous acid was possibly no better than a convenient fiction.

Dr. DIVERS called attention to the fact that, two years ago, Raschig (*Zeitsch. angew. Chem.*, 1905, **18**, 1281), and Rây and Gañguli (*Proc.*, 1905, **21**, 280), showed, independently, that nitric oxide distinctly forms nitrogen trioxide with oxygen before it goes on to produce nitric peroxide, and thus furnished chemical evidence, for the first time, of the existence of nitrous anhydride, N_2O_3, in the gaseous state.

Dr. BAKER, in reply, stated that sunlight had not been observed to exert any effect on nitrogen trioxide.

*208. "The atomic weight of tellurium." By Herbert Brereton Baker and Alexander Hutcheon Bennett.

The investigation of tellurium and the possibility of its containing another element has been the subject of study for the last thirteen years. The following methods were used in attempting to split up the element. (1) Fractional crystallisation of telluric acid prepared by two distinct processes. (2) Solution of barium tellurate in water. (3) Fractional distillation of (*a*) tellurium, (*b*) tellurium tetrachloride, and (*c*) tellurium dioxide. (4) Conversion of tellurium into the hydride. (5) Fractional electrolysis of tellurium tetrachloride and tetrabromide. (6) Fractional precipitation of tellurium tetrachloride by water.

In none of these processes was any difference found in the various fractions. Two methods were described for finding the equivalent of the element. The first, which depends on the reduction of the dioxide to the element by means of sulphur, gave 127·60 as the atomic weight (mean of 25 determinations), and the second, depending on the conversion of the element into the tetrabromide, gave 127·61 (mean of 18 determinations).

DISCUSSION.

The PRESIDENT remarked that no research is final, but this one must go a long way to settle the question of the homogeneity of tellurium.

Dr. Percy Williams, many years ago, carried out at University College some experiments on the subject. Tellurium, purified by crystallisation of its double bromide with potassium, gave, on reducing its oxide with hydrogen and absorbing volatilised metal with silver foil, the number 127·6 for the atomic weight. The double bromide, owing to the crystals retaining mother-liquor, was not adapted for an atomic weight determination.

*209. "The isomerism of the double sulphites of sodium and potassium." By Michael Harry Godby.

By neutralising potassium hydrogen sulphite with sodium hydroxide and sodium hydrogen sulphite with potassium hydroxide, two solutions are produced from which opaque, greasy crystals are obtained with some difficulty. They are of somewhat variable composition as regards water of crystallisation, and contain the metals in unequal atomic proportions, generally about 60 atoms of sodium to 40 of potassium.

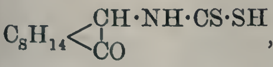
These crystals, when heated with ethyl iodide to 130—140° in a sealed tube, yield a salt which can be crystallised from boiling alcohol and contains ethyl, sodium, potassium, iodine, and SO_3. In each case, there are present about 76 atoms of potassium for every 24 of sodium.

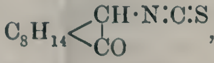
An attempt was made to prepare the double sulphites from the two solutions by precipitating with alcohol, as recommended by Rohrig. Fine powdery, white crystals were obtained having almost exactly the composition required for $KNaSO_3$.

These crystals, when heated with ethyl iodide as before and the product extracted with boiling alcohol, gave a white, finely-crystalline salt, which was recrystallised from boiling alcohol. This salt, whether obtained from the solution made originally by neutralising potassium hydrogen sulphite with sodium hydroxide or by neutralising sodium hydrogen sulphite with potassium hydroxide, contained sodium, potassium, ethyl, SO_3, and iodine in the same proportions, and approximated fairly closely to the salt prepared by Schwicker (*Ber.*, 1889, **22**, 1728) to which he ascribes the formula $4(KEtSO_3)NaI$, but contained 28 atoms of sodium to 72 of potassium, instead of 20 to 80 respectively.

There is no evidence for the existence of two isomeric salts, $KO\cdot SO_2Na$ and $NaO\cdot SO_2K$.

*210. "Studies in the camphane series. Part XXIV. Camphoryldithiocarbamic acid and camphorylthiocarbimide." By Martin Onslow Forster and Thomas Jackson.

Camphoryldithiocarbamic acid,  $C_8H_{14}\left\langle\begin{array}{l}CH\cdot NH\cdot CS\cdot SH\\ |\\ CO\end{array}\right.$, prepared from aminocamphor and carbon disulphide, is much more stable than compounds of this class which have been hitherto described, and does not decompose below its melting point, 128°. The *methyl* ester, $C_{12}H_{19}ONS_2$, melts at 147°, and is resolved into camphorylthiocarbimide and methyl mercaptan at 170°; the *benzoyl* derivative, $C_{18}H_{21}O_2NS_2$, crystallises from petroleum in colourless, silky needles melting at 105°. Nitrous acid oxidises the dithiocarbamic acid to the thiocarbimide and sulphur, but if amyl nitrite is added to an ethereal solution of the acid an intermediate *compound,* $C_{11}H_{15}ONS_2$, is produced, which melts at 110°, and breaks up readily into sulphur and the mustard oil.

Camphorylthiocarbimide,  $C_8H_{14}\left\langle\begin{array}{l}CH\cdot N:C:S\\ |\\ CO\end{array}\right.$, obtainable in a variety of ways from the dithiocarbamic acid, melts at 106·5°, and combines readily with bases, but less freely with alcohols; *camphorylthiocarbamide,* $C_{11}H_{18}ON_2S$, arising from it by the action of dry ammonia, melts at 180°, and *dicamphorylthiocarbamide,* $C_{21}H_{32}O_2N_2S$, obtained by prolonged treatment with water, melts at 176°. *Camphorylphenylthiosemicarbazide,* $C_{17}H_{23}ON_3S$, occurs in two modifications, melting at 183° and 163° respectively; these are distinguishable by a variety of colour reactions, and by the readiness with which the less fusible form passes into the *anhydride,* $C_{17}H_{21}N_3S$, which melts at 235°.

Discussion.

Mr. W. C. Reynolds observed that supersaturated solutions of the alkaloid hyoscyamine in some solvents, such as water and wet ether, behaved in a similar manner to the case described by Dr. Forster.

Mr. A. C. Chapman remarked that the glucoside apiin was another substance in which a remarkable relationship existed between the jelly and the crystalline forms.

The President suggested the analogy between the phenomena mentioned by Dr. Forster and other gentlemen and superfusion. Alcohol, when cooled, solidifies to a glass; on standing for a couple of days, crystallisation sets in, as indeed it does in the long run with ordinary glass. In the instances adduced by Dr. Forster, no doubt surface tension phenomena are concerned.

*211. "The vapour pressures of triethylamine, of 2:4:6-trimethylpyridine, and of their mixtures with water." By Robert Tabor Lattey.

A study of the total pressure curves for these mixtures shows that they conform to the type predicted by theory. The partial pressure curves can be calculated by a form of the Duhem-Margules equation. In both cases the curves show a maximum where the compositions of vapour and liquid are identical. At temperatures where the miscibilities of the components are limited there are indications of a second maximum inside the "unreal" parts of the curves.

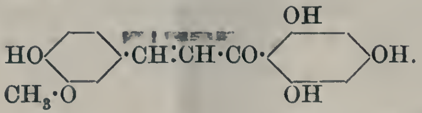
*212. "Liquid triethylamine." By Robert Tabor Lattey.

A comparison of the vapour pressures and critical constants of triethylamine and other liquids leads to the belief that the amine is a unimolecular liquid. This is confirmed by a determination of the temperature-coefficient of the molecular surface energy.

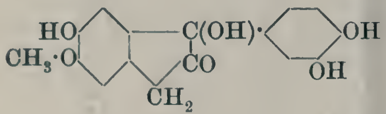
*213. "Note on the constitution of homoeriodictyol." By Frederick Belding Power and Frank Tutin.

At the meeting of the American Pharmaceutical Association held in September, 1906, a paper was communicated by the authors entitled "Chemical Examination of Eriodictyon" (*Proc. Amer. Pharm. Assoc.*, 1906, **54**, 352; Abstr., 1906, ii, 885). In this communication, we described the isolation and properties of three new crystalline substances, one of which possessed the formula $C_{16}H_{14}O_6$, and was designated homoeriodictyol. Early in the following year, G. Mossler (*Annalen*, 1907, **351**, 233) described the results of an examination of the same drug. Mossler had also isolated from *Eriodictyon* leaves the substance possessing the formula $C_{16}H_{14}O_6$, but proposed to name it "eriodictyonon."

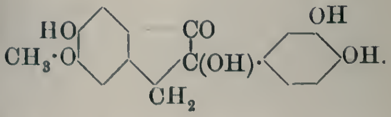
At the time of the appearance of the latter paper, we were engaged in further work on homoeriodictyol, the results of which (*Trans.*, 1907, **91**, 889) led us to assign to this substance the following constitutional formula:



We have recently been favoured by Dr. Mossler with a reprint of a paper communicated by him to the Academy of Sciences in Vienna (*Sitzungsber. K. Akad. Wiss. Wien.*, 1907, **116**, ii, June, 1907) at a time when he was unaware of our second investigation. In this most recent paper, he sets forth the conclusion that homoeriodictyol ("eriodictyonon") is represented by one of the following formulæ:



or



It is stated by Mossler that the action of alkalis on homoeriodictyol results only in the formation of a red resin, but this is not the case, as it was shown in our second communication that the product of this action, although highly coloured and containing a considerable amount of tarry matter, consists to a large extent of a mixture of phloroglucinol and ferulic acid. It follows from this that neither of the above formulæ proposed by Mossler can correctly represent the constitution of homoeriodictyol, as substances possessing such configurations could not possibly give rise to phloroglucinol. On the other hand, a ready explanation of the formation of all the substances obtained from homoeriodictyol by Mossler is afforded by assigning to this compound the constitution which we have proposed.

Although the observation, recorded by Mossler, that the action of bromine on homoeriodictyol is one of substitution, and not of addition, might be taken as evidence in support of the conclusion that the latter substance was saturated, it cannot be considered as proof that an ethylenic linking is not present.

The statement made by Mossler that homoeriodictyol possesses optical activity, is in direct conflict with our views regarding the constitution of this substance, as the formula we have proposed contains no asymmetric carbon atom. We had previously examined tetra-acetylhomoeriodictyol polarimetrically, but without being able to detect any optical activity, and have now repeated this experiment with the same result. Homoeriodictyol, also, has now been examined in this direction, and we can definitely state that our material is optically inactive. So far as we are aware, therefore, no facts have yet been recorded which are not in harmony with the formula we have assigned to homoeriodictyol.

214. "The alkyl compounds of gold. Diethylauric bromide." (Preliminary note.) By William Jackson Pope and Charles Stanley Gibson.

Auric bromide reacts vigorously with magnesium ethyl bromide in ethereal solution, and from the product *diethylauric bromide,* $(C_2H_5)_2AuBr$, has been separated; this is the first alkyl gold compound to be described.

Diethylauric bromide dissolves in the ordinary organic solvents, but is insoluble in water. It crystallises in long, colourless needles which melt at 58° with slight decomposition; on rapid heating, it decomposes explosively at about 70°. The compound has an odour resembling that of bromocamphor, and volatilises on warming in a vacuum. It is much more readily acted on by reagents than is the recently discovered trimethylplatinic iodide, $(CH_3)_3PtI$; thus the former yields crystalline products on treatment with ammonia and nitric acid, whilst the latter is unaffected by those reagents.

The study of the alkyl compounds of the metals of groups I and VIII of the periodic classification is being continued.

215. "The interaction of methylene chloride and the sodium derivative of ethyl malonate." (A correction.) By Frank Tutin.

In a paper bearing the above title (*Trans.*, 1907, **91**, 1141), three crystalline substances were described as by-products of the reaction which takes place when methylene chloride is heated with the sodium derivative of ethyl malonate. It has now been ascertained that one of these substances, described as "the yellow sodium salt," is the sodium derivative of "ethyl dicarboxyglutaconate," and had been formed from chloroform which was present as an impurity in the methylene chloride. The acid obtained by the hydrolysis of this sodium compound, and to which the formula $C_{10}H_{12}O_8$ was assigned, must, therefore, have been glutaconic acid, $C_5H_6O_4$.

216. "Preparation of aliphatic nitro-compounds by the interaction of the alkyl iodides and mercurous nitrite." By Prafulla Chandra Rây and Pañchañan Neogi.

By the interaction of mercurous nitrite and the alkyl iodides, namely, methyl, ethyl, *iso*propyl, and *iso*amyl iodides, the corresponding nitro-compounds and the esters are formed. In this respect, mercurous nitrite behaves exactly like silver nitrite. The yields obtained were as follows: [(*a*) = with silver nitrite, (*b*) = with mercurous nitrite]. Methyl iodide (28 grams) gave (*a*) methyl nitrite, 3·6 grams, and nitromethane, 4·0 grams, (*b*) 2·1 grams and 2·6 grams respectively. Ethyl iodide (60 grams) gave (*a*) ethyl nitrite, 12·8 grams, and nitroethane, 12·1 grams, (*b*) 8·8 grams and 9·2 grams respectively. *iso*Propyl iodide (34 grams) gave (*a*) *iso*propyl nitrite, 8·0 grams, and nitro*iso*propane, 6·3 grams, (*b*) 4·1 grams and 3·8 grams respectively.

*iso*Amyl iodide (76 grams) gave (*a*) *iso*amyl nitrite, 3·2 grams, and nitro*iso*pentane, 12·4 grams, (*b*) 3·2 grams and 7·8 grams respectively.

217. "Some mercury derivatives of camphor." By James Ernest Marsh and Robert de Jersey Fleming Struthers.

When camphor is heated with an alkaline solution of mercuric iodide, mercury derivatives of camphor are formed. By treatment with glacial acetic acid, *camphor dimercuri-iodide*, $C_{10}H_{14}O,Hg_2I_2$, is precipitated. The filtrate, when diluted with water, gives with potassium iodide, or, better, with a solution of mercuric iodide in potassium iodide, an orange precipitate of the double salt, $C_{10}H_{15}O,HgI + HgI_2$ This, on treatment with potassium iodide in neutral solution, gives *camphor murcuri-iodide*, $C_{10}H_{15}O,HgI$, which is pale yellow. The above-mentioned acetic acid solution also gives with potassium chloride and bromide white precipitates of *camphor mercurichloride*, $C_{10}H_{15}O,HgCl$, and *camphor mercuribromide*, $C_{10}H_{15}O,HgBr$, respectively, which, however, have not yet been obtained quite free from iodide.

218. "Contributions to the chemistry of the terpenes. Part II. T [illegible] of limonene with chromyl chloride." By George Gerald Henderson.

When a dilute solution of chromyl chloride in carbon disulphide is slowly added to a similar solution of limonene, an *additive product*, $C_{10}H_{16},2CrO_2Cl_2$, is precipitated. This compound is a brown powder, which begins to decompose in moist air, and at once reacts with water, yielding a solution of chromic chloride, some resinous matter, and a brown, viscous liquid insoluble in water. When subjected to distillation in steam, the brown liquid yields a further quantity of resinous matter and a clear yellow oil, which is composed of an aldehyde, a ketone, and a very unstable substance containing chlorine as well as oxygen. The *aldehyde*, $C_{10}H_{14}O$, is a strongly odorous, oily liquid, b. p. 221—222°/755 mm. It yields a crystalline *semicarbazone*, m. p. 156°. It is unsaturated, and on exposure to air it is converted into the corresponding *acid*, $C_{10}H_{14}O_2$, which forms small, colourless crystals, m. p. 172°. The *silver* salt of the acid crystallises in small, white prisms. Boiling dilute nitric acid converts the aldehyde slowly into *p*-toluic acid; this is also the chief product when the aldehyde is oxidised with a dilute solution of potassium permanganate. The *ketone*, $C_9H_{12}O$, is the chief constituent of the oxidation product. It is an almost colourless, oily liquid with a strong odour, b. p. 112—113°/15 mm. It is unsaturated. The *semicarbazone* of the ketone crystallises with one molecule of methyl alcohol in colourless prisms which quickly effloresce in the air. After heating at 100°, it melts at 205°. When heated with ammonium formate in a sealed tube, the ketone is converted into the formyl derivative of an amine, from which the free *amine*, $C_9H_{13}\cdot NH_2$, is obtained by hydrolysis with alcoholic potash. It is a colourless, oily liquid with a disagreeable odour and an alkaline reaction, and is almost insoluble in water. The hydrochloride and the sulphate of the amine are deliquescent and very readily soluble in water or alcohol; the *platinichloride*, which is very sparingly soluble in water, crystallises in small, brownish-yellow needles. The chlorinated oxidation product is so unstable that it could not be isolated.

219. "The synthesis of acridines and phenonaphthacridines: tetra- and hexa-methylacridines: dimethylphenonaphthacridines: dixylylmethylenediamines." By Alfred Senier and Arthur Compton.

By the interaction of methylene dichloride and xylidines, with or without xylenols, two methylenediamines are formed which by means of Ullmann's method of substitution (*Ber.*, 1903, **36**, 1019) give rise to two corresponding acridines. One of the latter can also be obtained by heating the methylenediamine to a higher temperature, whereas the other cannot. This is explained by assuming that, when the *p*-position with respect to the amino-group in the arylamine is not substituted, the methylenediamine first formed is changed by metastasis to a methylenebenzidine (*pp*-diaminodiarylmethane) from which no acridine can result.

When, however, the *p*-position is occupied by an alkyl group, the metastatic action produces an *oo*-diaminodiarylmethane from which an acridine is easily derived. By the interaction of methylene dichloride and mixtures of xylidines and naphthols, corresponding dimethylphenonaphthacridines are obtained.

The following compounds were described. *Di*-1 : 3 : 4-*xylylmethylenediamine* (compare Senier and Goodwin, *Trans.*, 1902, **81**, 284). 1 : 3 : 7 : 9-*Tetramethylacridine;* its *platinichloride, aurichloride,* and *picrate.* *Di*-1 : 4 : 5-*xylylmethylenediamine* and its *platinichloride.* 1 : 4 : 6 : 9-*Tetramethylacridine* and its *aurichloride.* 1 : 3 : 4 : 6 : 7 : 9-*Hexamethylacridine* (compare Senier and Goodwin, *loc. cit.*). *Di*-ψ-*cumylmethylenediamine.* 9 : 11-*Dimethylpheno*-$\underset{\text{CH}\beta}{\overset{\text{N-}\alpha}{|}}$-*naphthacridine* and its *platinichloride.* 9 : 11-*Dimethylpheno*-$\underset{\text{CH}\alpha}{\overset{\text{N-}\beta}{|}}$-*naphthacridine* (compare Ullmann, *Chem. Centr.*, 1901, ii, 568). 8 : 11-*Dimethylpheno*-$\underset{\text{CH}\beta}{\overset{\text{N-}\alpha}{|}}$-*naphthacridine* and its *platinichloride.* 8 : 11-*Dimethylpheno*-$\underset{\text{CH}\alpha}{\overset{\text{N-}\beta}{|}}$-*naphthacridine* and its *platinichloride.*

220. "Chemical examination of the root and leaves of Morinda longiflora." By Marmaduke Barrowcliff and Frank Tutin.

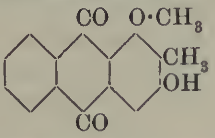
The root and leaves of *Morinda longiflora*, G. Don, a West African plant known as "Ojuologbo," and stated to possess valuable medicinal properties (*Journ. Soc. Arts.*, 1905, **53**, 1069), have been chemically examined.

The ground materials were extracted with hot alcohol, and the resulting extracts separately investigated. No alkaloid was present in either material.

The extract yielded by the root gave a small quantity of a *hydroxymethoxymethylanthraquinone*, $C_{16}H_{12}O_4$ (m. p. 290°), and a small amount of a monoethyl ether of alizarin. It also yielded, in addition to resins and other amorphous products, formic, acetic, butyric, palmitic, and citric acids, a phytosterol, $C_{27}H_{46}O$ (m. p. 130°), and a large amount of a sugar which gave *d*-phenylglucosazone (m. p. 215°).

The extract of "Ojuologbo" leaves gave, in addition to some of the substances mentioned above, a small amount of the hydrocarbon hentriacontane, and a new, crystalline *alcohol*, $C_{33}H_{61}O_3\cdot OH$ (m. p. 278°; $[\alpha]_D + 65\cdot 9°$), designated *morindanol.* This compound, on treatment with sodium ethoxide and methyl iodide, yields *methylmorindanol*, $C_{33}H_{61}O_3\cdot OCH_3$ (m. p. 116°).

The above-mentioned hydroxymethoxymethylanthraquinone yields, on methylation, 1 : 3-*dimethoxy*-2-*methylanthraquinone* (m. p. 181°), and, on heating with 70 per cent. sulphuric acid, it gives 1 : 3-dihydroxy-2-methylanthraquinone. It must therefore be represented by one of the following formulæ:



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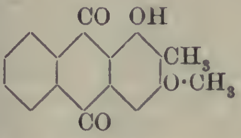


On heating with hydriodic acid, it yields a *dihydroxymethylanthranol*, $C_{15}H_{12}O_3$ (m. p. 235°).

The monomethyl ether of alizarin is identical with the compound of this nature which was isolated by Perkin and Hummel (*Trans.*, 1893, **63**, 1174) from "Chay root."

Neither of the extracts possessed any pronounced physiological activity.

221. "Ethyl α-cyano-γ-phenylacetoacetate."

By Arthur Richard Smith and Jocelyn Field Thorpe.

Contrary to the observation of Haller, it is found that ethyl α-cyano-γ-phenylacetoacetate, $CH_2Ph\cdot CO\cdot CH(CN)CO_2Et$, is a well-defined, crystalline substance, which melts at 25°, and distils without decomposition at 178° (20 mm.). The compound is a strong acid, readily decomposing carbonates, and yielding salts which can be recrystallised from water without undergoing dissociation. The alkali salts are not acted on by alkyl iodides, but if the silver salt is treated, in dry ether solution with ethyl iodide a mixture of *ethyl α-cyano-γ-phenyl-α-ethylacetoacetate*, $CH_2Ph\cdot CO\cdot CEt(CN)CO_2Et$, and *ethyl α-cyano-β-ethoxy-γ-phenylcrotonate*, $CH_2Ph\cdot C(OEt)\dot{:}C(CN)CO_2Et$, is produced. The former is a liquid boiling at 190—191° (20 mm.), and the latter a solid melting at 66°. Characteristic derivatives of ethyl α-cyano-γ-phenylacetoacetate and of the two forms of its ethyl derivative were described.

222. "Aromatic amides and imides of camphoric acid."

By William Ord Wootton.

The substance obtained by the action of nitrous acid on camphorylphenylhydrazide is found to be N-*nitrosocamphorylphenylhydrazide*, $C_8H_{14}<\genfrac{}{}{0pt}{}{CO}{CO}>N\cdot N(NO)\cdot C_6H_5$, m. p. 157°, and not a nitro-compound as stated by E. M. Chaplin (*Ber.*, 1892, **25**, 2565). N-*Nitrocamphorylphenylhydrazide*, $C_8H_{14}<\genfrac{}{}{0pt}{}{CO}{CO}>N\cdot N(NO_2)\cdot C_6H_5$, may be prepared by the action of nitric acid and acetic anhydride on camphorylphenylhydrazide, and forms colourless prisms melting and decomposing at 115—116°.

Camphoryl-4-bromophenylhydrazide, $C_8H_{14}<\genfrac{}{}{0pt}{}{CO}{CO}>N\cdot NH\cdot C_6H_4Br$, and *camphoryldibromophenylhydrazide* have been prepared, together with their N-*nitroso*- and N-*nitro*-derivatives. It is found in each case that the nitroso-derivatives are pale yellow, whilst the nitro-compounds are colourless. The fact that the latter are readily reduced with elimination of ammonia indicates that the nitro-group is not attached to the benzene nucleus.

Camphoric anhydride combines with *p*-bromoaniline at 120° to form 4-*bromophenyl-a-camphoramic acid*, $CO_2H\cdot C_8H_{14}\cdot CO\cdot NH\cdot C_6H_4Br$, m. p. 207°. Reduction of the *nitro*-derivative of this acid yields 4-*bromo-3-aminophenyl-a-camphoramic acid*, m. p. 207°. 4-*Bromo-3-aminophenylcamphorimide*, $C_8H_{14}<\genfrac{}{}{0pt}{}{CO}{CO}>N\cdot C_6H_3Br\cdot NH_2$, has also been obtained. These two amino-compounds are optically active, and it is the author's intention to utilise them and certain of their derivatives in the study of racemic aldehydes.

Camphoric anhydride and aminoazobenzene combine to form 4-*benzeneazophenyl-a-camphoramic acid*,

$$CO_2H\cdot C_8H_{14}\cdot CO\cdot NH\cdot C_6H_4\cdot N_2\cdot C_6H_5,$$

m. p. 223—224°. On reduction, 4-*aminophenyl-a-camphoramic acid* is obtained.

223. "The melting point of *d*-phenylglucosazone." By Frank Tutin.

During the past few years a number of plants have been submitted to exhaustive investigation in the Wellcome Chemical Research Laboratories, and in all cases where sugar was found to be present the osazones were prepared. In a number of instances the phenylosazone obtained melted at a temperature considerably higher than that at which *d*-phenylglucosazone is stated to fuse, namely 205°. Several of these preparations melted at or above 215°, whilst the osazone yielded by the sugar contained in the leaves of *Gymnema sylvestre* (Power and Tutin, *Pharm. J.*, 1904, **73**, 234) fused at 218—219°. Analyses of these preparations of high melting point showed that they were the osazones of hexoses, and as the only compound of this class stated to melt above 206° is α-acrosazone (m. p. 217°), it was at first thought that they must be identical with this compound and were derived from inactive sugars.

It was, therefore, deemed of importance to recrystallise and examine a number of the specimens of osazones which had been prepared from plant sugars by different workers in these laboratories. With this end in view experiments were instituted with the object of finding a better means of purifying osazones than by recrystallisation from alcohol, and it was ascertained that the use of pyridine was attended with excellent results. The osazone was dissolved in a small quantity of boiling pyridine, hot alcohol and subsequently a little water added, when, on allowing the mixture to cool, the osazone separated in a pure condition.

Specimens of osazones prepared from plant sugars were then recrystallised in this manner, with the results shown in the following table:

Source of sugar.	Original melting point of osazone.	Melting point after recrystallisation.
Brucea antidysenterica (fruit) ……	205°	217°
,, ,, (bark) ……	205	215—216
Gymnema sylvestre (leaves) … ….	218—219	217
Aethusa cynapium (herb) ………..	218	217
Grindelia camporum (herb) .. ……	205—206	216
Chailletia toxicaria (fruit)………..	211—212	216
Eriodictyon Californicum (leaves)…	205	216—217
Morinda longiflora (root) ………..	215	216
Lippia scaberrima (herb) ……….	210	216—217
Ipomoea purga (tuber) … . ………	217—218	217—218
Olea Europaea (bark)………………	216	217
Micromeria Chamissonis (herb)… ..	205	217

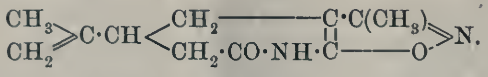
A specimen of *d*-phenylglucosazone (from dextrose) melting at 205° was then recrystallised in a similar manner, after which it melted at 217°. Furthermore, it was found that *d*-phenylglucosazone, when prepared from dextrose by the aid of freshly distilled phenylhydrazine, and avoiding a too protracted period of heating, exhibited an initial melting point of 216°.

It is evident, therefore, that *d*-phenylglucosazone, when pure, melts at about 217°, and not at 205° as stated by Fischer (*Ber.*, 1884, **17**, 579).

On referring to the original papers on the subject it will be found that α-acrosazone was originally obtained melting at 205° (Fischer and Tafel, *Ber.*, 1887, **20**, 1093), and that it was only after careful purification that it exhibited a melting point of 217° (*ibid.*, p. 3389). It is evidently owing to the fact that *d*-phenylglucosazone was not submitted to an equally elaborate process of purification (*loc. cit.*) that the correct melting point of this substance was not initially observed.

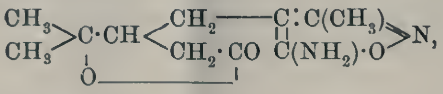
224. "The interaction of cyanodihydrocarvone, amyl nitrite and sodium ethoxide. Part II. The constitution of the products." By Arthur Lapworth and Elkan Wechsler.

The compound obtained as the product in the above reaction and referred to in the first paper (*Trans.*, 1907, **91**, 978) as "the lactam" (*L*), has the constitution :



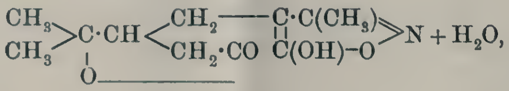
$$\begin{matrix}CH_3\\CH_2\end{matrix}\!\!>C\cdot CH<\begin{matrix}CH_2\text{———}C\cdot C(CH_3)\\ \qquad\qquad\quad\; \| \qquad\qquad\quad \\ CH_2\cdot CO\cdot NH\cdot C\text{———}O\end{matrix}\!\!>N.$$

The derived amino-acid (*A*), when acted on by acids, is converted into the "lactonic base" (*B*),



$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\underset{\lfloor O\text{————}\rfloor}{C\cdot CH}<\begin{matrix}CH_2\text{——}C\colon C(CH_3)\\ \qquad\qquad \| \\ CH_2\cdot CO\;\; C(NH_2)\cdot O\end{matrix}\!\!>N,$$

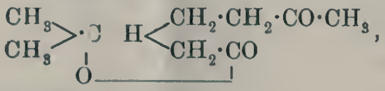
and the "lactonic acid,"



$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\underset{\lfloor O\text{————}\rfloor}{C\cdot CH}<\begin{matrix}CH_2\text{——}C\cdot C(CH_3)\\ \qquad\qquad \| \\ CH_2\cdot CO\;\; C(OH)\text{–}O\end{matrix}\!\!>N+H_2O,$$

successively.

On reduction with ferrous hydroxide in alkaline solution, the latter yields pure *d*-homoterpenoyl methyl ketone,



$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\underset{\lfloor O\text{————}\rfloor}{\cdot C\;\; H}<\begin{matrix}CH_2\cdot CH_2\cdot CO\cdot CH_3\\CH_2\cdot CO\end{matrix},$$

ammonia and carbonate.

The isomeric "lactonic base" (*B′*), erroneously assigned $[\alpha]_D$ 6·21, is quite inactive and on reduction yields inactive homoterpenoyl methyl ketone. This base is therefore a racemic form of *B*. The isomeric lactam (*L′*), is strongly active, but also yields the inactive keto-lactone on reduction.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Hazen, *Allen.* Clean water and how to get it. pp. x + 178. ill. New York [1907]. (*Recd.* 16/10/7.)
From the Publishers: Messrs. John Wiley and Sons.

Luxmoore, *C. M.* The soils of Dorset. A report on their mechanical and chemical composition and on their physical properties. pp. 36. 1907. (*Recd.* 14/10/7.) From the Author.

Martin, *Geoffrey.* Practical chemistry for army and matriculation candidates. pp. viii + 144. ill. London 1907. (*Recd.* 5/10/7.)
From the Publishers: Messrs. Crosby Lockwood and Son.

Muir, *M. M. Pattison.* A history of chemical theories and laws. pp. xx + 555. New York 1907. (*Recd.* 17/7/7.)
From the Publishers: Messrs. John Wiley and Sons.

Nissenson, *H.* Die Untersuchungsmethoden des Zinks unter besonderer Berücksichtigung der technisch wichtigen Zinkerze. (Die chemische Analyse, Vol. II.) pp. 140. Stuttgart 1907. (*Rec* 31/7/7.) From the Publisher: Ferdinand Enke.

Palmer, *John Dabney.* Practical test-book of chemistry. pp. x + 190. New York 1907. (*Recd.* 16/9/7.)
From the Publishers: Messrs. John Wiley and Sons.

Royal Society of London. Some account of the "classified papers" in the archives. With an index of authors. Compiled by *A. H.* **Church.** pp. 38. Oxford 1907. (*Recd.* 11/10/7.)
From Professor A. H. Church, F.R.S.

Schmidt, *Julius.* Die Anwendung der Hydrazine in der analytischen Chemie. (Die chemische Analyse, Vol. I.) pp. 92. Stuttgart 1907. (*Recd.* 31/7/7.) From the Publisher: Ferdinand Enke.

Seidell, *Atherton.* Solubilities of inorganic and organic substances. A handbook of the most reliable quantitative solubility determinations. pp. x + 367. New York and London. (*Recd.* 31/7/7.)
From the Publishers: Messrs. Crosby Lockwood and Son.

II. *By Purchase.*

Archiv für experimentelle Pathologie und Pharmakologie. Edited by *B.* **Naunyn** and *C.* **Schmiedeberg.** Vol. LVI, &c. Leipzig 1907 +.

Arrhenius, *Svante.* Theories of chemistry. Being lectures delivered at the University of California, in Berkeley. Edited by *T. Slater* **Price.** pp. xii + 212. London 1907. (*Recd.* 26/6/7.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 9th, 1907.

All persons who received grants in December, 1906, or in December of any previous year whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Monday, December 2nd, next.

At the next Ordinary Meeting on **Thursday**, November **21**st, 1907, at **8.30** p.m., the following papers will be communicated :

"The interaction of metallic sulphates and caustic alkalis." By S. P. U. Pickering.

"The chemistry of Bordeaux mixture." By S. P. U. Pickering.

"Aromatic azoimides. Part III. The naphthylazoimides and their nitro-derivatives." By M. O. Forster and H. E. Fierz.

"Studies of dynamic isomerism. Part VII. Note on the action of carbonyl chloride as an agent for arresting isomeric change." By T. M. Lowry and E. H. Magson.

"Emulsions." By S. P. U. Pickering.

"The electrometric measurement of the hydrolysis of the salts of aniline, ammonium, aluminium, chromium, thallium, zinc, magnesium, cerium, thorium, nickel, and cobalt." By H. G. Denham.

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Issued 3/12/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 332.

Thursday, November 21st, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

The PRESIDENT announced that the Society has received a portrait of Faraday and Daniell from Professor Meldola, and a silver medal from the Société Chimique de France, struck in commemoration of the recent Jubilee celebration.

Certificates were read for the first time in favour of Messrs.:

John Arthur Carpenter, B.A., New College, Oxford.
Cyril Dickinson, B.Sc., F.I.C., Abbotsford, Holycroft Avenue, Hampstead, N.W.
Edward Mortimer Eagles, M.A., 5, Winsham Grove, Clapham Common, S.W.
Robert Cecil Gale, 38, Scarsdale Villas, Kensington, W.
George Neville Pingriff, B.A., 39, Hall Road, Handsworth, Staffs.
William Bayliss Shaw, Lonsdale House, Walsall.
Harry Jackson Unwin, Market Place, Clay Cross, nr. Chesterfield.
Herbert Walker, Whyttington, Station Road, Wealdstone, N.W.
Joseph Henry Williams, 27, Canbury Avenue, Kingston-on-Thames.

Certificates have been authorised by the Council under Bye-law I (par. 3) in favour of the following:

Edward Henry Croghan, c/o Messrs. H. Eckstein & Co., P.O. Box 149, Johannesburg.
Charles Thomas Foreman, Jamalpur, E.I.R., Bengal.

Of the following papers, those marked * were read :—

*225. "Emulsions." By Spencer Pickering.

Paraffin oil, when churned with solutions of soap, glue, starch, albumin, &c., forms an emulsion which rises, like cream, to the surface of the excess of water, and contains from 65 to 82 per cent. by volume of the oil. Close-packing of uniform globules would give an emulsion containing 74 per cent. The percentage of oil can be increased to 99 per cent., the emulsion then being practically solid. Emulsification seems to depend on the separation from the liquid of very minute, solid particles which are attracted by, and surround, the oil globules, thus preventing them from coalescing. Any precipitated substance which is sufficiently finely divided will act as an emulsifying agent, but, after becoming agglomerated by drying, it loses this property. The basic sulphates of iron and copper are conspicuously good emulsifiers, and, when they are used instead of soap, it is possible to mix with the emulsions substances which could not be added if soap had been used; for example, sodium hydroxide. Solids which are not sufficiently fine grained to make true emulsions with oil, will sometimes made quasi-emulsions, in which the oil globules are merely entangled with the solid particles. In this case, dilution with water separates the oil from the solid, which is not the case with true emulsions.

Discussion.

Dr. Lewkowitsch thought that all the phenomena mentioned by the author could be best explained by the colloidal state of the substances employed. He would therefore take exception to the explanation that the paraffin oil emulsified the soap solution, and would prefer to say that the soap solution emulsified the paraffin oil. Soap solutions were typical colloids, easily gelatinisable even in dilute solutions, and it was also well known how disconcerting soap solutions were once they had formed an emulsion with other substances, notably vegetable or mineral oils. The percentage (97) of paraffin oil in the emulsion shown appeared very high, and he therefore asked how much water and how much soap, presumably soft soap, were in the remaining 3 per cent. Soap solutions emulsified, not only paraffin oils, but also alcohol and notably very large amounts of water.

The ferric sulphate and also the copper salt mentioned by the author were known to occur in the colloidal state, and therefore their property of forming emulsions would explain the phenomena referred to. The experiments shown with the emulsions produced by soap would fall in well with that explanation. On adding hydrochloric acid, the soap was decomposed with the formation of free fatty acids.

These, at any rate those formed in the given case, were not colloids, and therefore the emulsion was "broken" at once and water separated, the fatty acids remaining dissolved in the petroleum. The fact that caustic soda "broke" the emulsion was also easily explained, as caustic soda "salts out" soaps, that is, precipitates them from their colloidal solution, and therefore water must separate out again. That in the experiment with lime no emulsion was formed could also be readily explained by adopting his view, for under the given conditions lime would not behave like a colloid.

Mr. J. Castell-Evans thought that surface-tension had a great deal, if not all, to do with the formation of emulsions, and that many finely-divided substances may be found which will induce the formation of emulsions of petroleum and water. He instanced a case, falling within his own personal observation, in an attempt at "oil concentration" of the metalliferous contents of some calcined tailings. These tailings consisted largely of ferric oxide and, after calcination, had been "weathered" for many years. On shaking up with water and mineral oil of about 0·89 sp. gr., the silicious matter, as expected, sank to the bottom of the cylinder; so also did the coarser particles of ferric oxide, whilst the finer particles of the oxide remained in the oil, forming apparently a true emulsion. This "emulsion" did not make the sides of the cylinder oily, and remained persistent for many months. The coarser particles of the oxide did not present a sufficiently large surface, in proportion to their mass, to be retained by the petroleum.

Dr. Borns inquired whether the author had succeeded in obtaining any emulsions of oil and pure water. K. Beck (*Zeitsch. physikal. Chem.*, 1907, 58, 409) had found that the viscosity of water was not affected when the water was churned with oil. When he prepared an emulsion of oil and water by rubbing the oil with some gum arabic in a mortar and adding water, however, the viscosity of the water was increased.

The President suggested that the suspended particles in an emulsion may be similarly electrified, and so repel each other and fail to coalesce. No doubt this phenomenon is closely connected with surface-tension phenomena. The addition of electrolytes may possibly discharge the electrified particles and cause coalescence.

Mr. Pickering, in reply, stated that the strongest emulsion which he had obtained contained only 1 per cent. of a 1 per cent. soap solution. The action of soap as an emulsifying agent was very uncertain, but that was not the case with insoluble emulsifiers. Such colloids as he had tried did not emulsify, but, on the contrary, became gelatinised. The basic sulphates were clearly not colloids; the particles composing them could be seen under the microscope. No doubt surface-tension played an important part in emulsification, but that offered no explanation of the phenomenon. Electrolytes, as such, had no effect on emulsions.

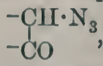
*226. "Aromatic azoimides. Part III. The naphthylazoimides and their nitro-derivatives." By Martin Onslow Forster and Hans Eduard Fierz.

For the purpose of studying further the triazo-group, and the conditions under which its properties are influenced by other groups, azoimides of the naphthalene series have been examined.

a-Naphthylazoimide, $C_{10}H_7 \cdot N_3(\alpha)$, melts at 12°, and does not yield hydrazoic acid when heated with alcoholic potash; the 2-*nitro-* and 4-*nitro*-derivatives, melting at 103—104° and 99° respectively, are resolved into the corresponding nitronaphthols and hydrazoic acid. The heteronucleal 5-*nitro-* and 8-*nitro*-1-*naphthylazoimides,* melting at 121° and 130—131° respectively, do not furnish hydrazoic acid.

β-Naphthylazoimide, $C_{10}H_7 \cdot N_3(\beta)$, melts at 33°, and, like the heteronucleal 5-*nitro-* and 8-*nitro*-2-*naphthylazoimides,* melting at 133·5° and 108° respectively, does not give hydrazoic acid. 1-*Nitro*-2-*naphthylazoimide,* melting at 116—117°, is characterised by the readiness with which it loses nitrogen when heated, passing into the peroxide of β-naphthaquinonedioxime, which is also obtained, but less readily, from the 2-nitro-1-naphthylazoimide; the 1-nitro-2-naphthylazoimide yields hydrazoic acid when heated with alcoholic potash.

*227. "The triazo-group. Part I. Triazoacetic acid and triazoacetone (acetonylazoimide)." By Martin Onslow Forster and Hans Eduard Fierz.

The interesting properties displayed by the triazo-group when occurring in the complex,  $\begin{array}{l} -CH\cdot N_3 \\ \;| \\ -CO \end{array}$, have led the authors to prepare the simplest typical compounds of this class, triazoacetic acid and triazoacetone.

Triazoacetic acid, $N_3 \cdot CH_2 \cdot CO_2H$, is a colourless substance, which crystallises in lustrous, transparent, hygroscopic plates, melting at 16°; it is a strong acid, has a faint odour recalling that of butyric acid, but much less pungent, and when dropped on a hot iron plate detonates with a moderate explosion, taking fire. The *silver* salt, $C_2H_2O_2N_3Ag$, crystallises from boiling water in lustrous, colourless needles, which decompose slowly when exposed to light; the *ethyl* ester, $C_4H_7O_2N_3$, is a limpid, colourless oil, which boils at 45° under 2 mm. pressure, and has a very faint odour recalling chloroform rather than ethyl acetate. *Triazoacetamide*, $N_3{\cdot}CH_2{\cdot}CO{\cdot}NH_2$, crystallises from benzene in long, lustrous, colourless needles, melting at 58°.

The derivatives of triazoacetic acid are much more sluggish in their reaction with concentrated sulphuric acid than is usually the case among compounds containing the triazo-group; when shaken vigorously with the acid, however, nitrogen is liberated. A neutral solution of potassium triazoacetate may be boiled without undergoing change, but in presence of free alkali, two-thirds of the azidic nitrogen is eliminated in the elemental form, the remainder separating as ammonia.

Triazoacetone (*acetonylazoimide*), $N_3{\cdot}CH_2{\cdot}CO{\cdot}CH_3$, is a colourless, limpid oil, which boils at 54° under 2 mm. pressure; the freshly prepared substance has a very faint odour recalling that of chloroacetone, but much less pungent, spontaneously acquiring a suggestion of carbylamine after a few days. It is moderately soluble in water, and when shaken with dilute aqueous potash briskly liberates nitrogen, gas evolution being almost explosive when a 40 per cent. solution of alkali is used; dropped on a hot iron plate, the substance detonates feebly, taking fire, and concentrated sulphuric acid decomposes it immediately. The *semicarbazone*, $C_4H_8ON_6$, crystallises from hot water or absolute alcohol in long, lustrous needles, which melt without evolving gas at 152°.

The triazo-derivatives of acetone and acetic ester were prepared by the action of sodium azide on the respective chloro-compounds. The authors are engaged in a study of the products obtainable from salts of hydrazoic acid and the halogen derivatives of acids, esters, ketones, aldehydes, and alcohols.

DISCUSSION.

Dr. KEANE asked whether Dr. Forster had examined the decomposition products of the azoimides of acetic acid and ethyl acetate when two-thirds of the total nitrogen was eliminated, and if so, whether imide derivatives of the aldehydes were obtained as in the case of the camphorylazoimide?

Dr. FORSTER replied that these compounds were being investigated.

*228. "Studies of dynamic isomerism. Part VII. Note on the action of carbonyl chloride as an agent for arresting isomeric change." By Thomas Martin Lowry and Egbert Hockey Magson.

Labile solutions of nitrocamphor, in which isomeric change has been suspended, have been prepared (1) accidentally by dissolving nitrocamphor in chloroform, and (2) deliberately by adding acid to the solvent chloroform. In the latter case, the solutions acquired a powerful odour of carbonyl chloride, and there can be no doubt that this is the efficient agent in arresting isomeric change in chloroform solutions.

By means of this new agent, it is possible to arrest the isomeric change of nitrocamphor in other solvents. Thus a solution in benzene and $N/10,000$ carbonyl chloride, when stored in a quartz flask, showed a change of rotatory power of only 1·4° in twenty-five days, whilst a solution to which no carbonyl chloride had been added showed a similar change in four hours. In the same way, the velocity of isomeric change in ether was reduced to one-twentieth by the addition of $N/10,000$ carbonyl chloride, but no retardation was produced by the addition of acetic anhydride to acetic acid.

*229. "The electrometric determination of the hydrolysis of salts."
By Henry George Denham.

The author has measured the hydrolysis of salt solutions with the hydrogen electrode. The *E.M.F.* of the cell, Pt_{H_2} | salt solution | saturated sol. of NH_4NO_3 | calomel electrode, was measured, and from this the concentration of the hydrogen ion was calculated.

A redetermination of the hydrolysis of solutions of aniline, chromium, and aluminium salts gave results agreeing well with those obtained by Ley (*Zeitsch. physikal. Chem.*, 1899, **30**, 193; Bruner, *ibid.*, 1900, **32**, 133; Bredig, *ibid.*, 1894, **13**, 289, and Bjerrum, *ibid.*, 1907, **59**, 336). In the case of the green chromium sulphate, the results obtained point to the conclusion that the equation given by Recoura (*Ann. Chim. Phys.*, 1895, [vii], **4**, 494) for the conversion of the blue sulphate into the green is not valid, but that the acid formed is produced through hydrolysis, and its amount depends only on the concentration and the temperature of the solution.

In the case of the salts of zinc, magnesium, thorium, cobalt, and nickel, peculiar variations in the hydrogen ion concentrations have been noticed from day to day. The most probable explanation of this appears to be that the hydrolysis of these salts lead to heterogeneous systems, in which the second phase (hydroxide or basic salt) is present in a colloidal form.

230. "The interaction of metallic sulphates and caustic alkalis." By Spencer Pickering.

Alkalis, added to solutions of various metallic sulphates, precipitate a definite basic sulphate, except in the case of manganese and magnesium, where the hydroxide is precipitated. After the precipitation is complete, the further addition of alkali converts the basic sulphate either into another, sometimes consecutively into two other, more basic products (for example, copper and nickel), or into the hydroxide (aluminium). When one of the stronger alkalis (potash, soda) is used in excess, the product is probably always the hydroxide, but in the case of lime this does not appear to be so, at any rate not with the sulphates of copper and nickel (see the following communication). In every case examined, different alkalis have given the same results as regards the basicity of the sulphates precipitated by them in each particular case. The existence of the following eleven basic sulphates has been established in this way; the predominence of 5 as the coefficient of equivalents of metallic oxide present is very noticeable. Those marked with an asterisk are the ones formed when the whole of the metal has been precipitated from the solution; the others are products of the action of further quantities of alkali: $5NiO,3SO_3$*, $5NiO,2SO_3$, $5Al_2O_3,3 \times 2SO_3$*, $4CuO,SO_3$*, $4CoO,SO_3$*, $4CdO,SO_3$*, $5CuO,SO_3$, $5NiO,SO_3$, $5ZnO,SO_3$*, $10CuO,SO_3$, $10FeO,SO_3$*.

231. "The chemistry of Bordeaux mixture." By Spencer Pickering.

The substances formed on the addition of lime to copper sulphate, as in the preparation of Bordeaux mixture, are dependent on the proportions of lime used, and may be either (1) $4CuO,SO_3,0{\cdot}06CaSO_4$; (2) $5CuO,SO_3,0{\cdot}25CaSO_4$; (3) $10CuO,SO_3,1{\cdot}3CaSO_4$;

(4) $10CuO,SO_3,4CaO,SO_3$;

(possibly 5) $10CuO,SO_3,10CaO,SO_3$, or (6) $CuO,3CaO$; that present in most cases probably being (4).

The fungicidal action of Bordeaux mixture seems to depend on the liberation of normal copper sulphate by the action of carbon dioxide on the basic sulphate. The action begins only after a certain lapse of time, the basic calcium sulphate having to be decomposed before the basic copper sulphate is attacked. By using only sufficient lime to form $4CuO,SO_3$, the presence of basic calcium sulphate and the consequent delay in the action is avoided; in addition to this, the amount of normal copper sulphate liberated (for a given amount of copper sulphate taken) and the insecticidal value of the mixture will be two and a half times as great as when it consists of $10CuO,SO_3,4CaO,SO_3$.

The basic sulphates, when precipitated by lime in presence of excess of sodium sulphate, contain sodium sulphate as well as calcium sulphate; the formula of the most basic sulphate is $10CuO,SO_4,(Na_2,Ca)SO_4$. When precipitated by soda, they contain no appreciable amount of sodium sulphate, unless a large excess of the latter is present in the liquid.

Nickel sulphate with lime gives a basic sulphate containing a very little calcium sulphate, but, if the lime is at all times in excess, the basic sulphate is deprived of most of its acid, the precipitate consisting essentially of a double oxide.

232. "The alcohols of the hydroaromatic and terpene series. Part I. Resolution of the alcohols into their optically active components and the preparation of the borneols." By Robert Howson Pickard and William Oswald Littlebury.

An alternate method to that of the authors' (*Proc.*, 1906, **22**, 71) for the resolution of racemic alcohols was described. The alcohol is combined with phthalic or succinic anhydride, and the resulting acid ester resolved by *l*-menthylamine or other strong optically active base. The optically active acid ester thus obtained is readily hydrolysed and yields the active alcohol in a pure state.

l-Borneol was purified by three independent methods and found to have $[\alpha]_D$ $-37{\cdot}9°$ in toluene solution. *d*-Borneol was obtained from the reduction products of camphor by (i) treatment with zinc chloride in benzene solution, followed by (ii) conversion in the hydrogen phthalate and purification by means of the *l*-menthylamine salt. It then has $[\alpha]_D$ $+37{\cdot}8°$ in toluene solution.

*iso*Borneol (from camphene) was converted into the hydrogen phthalate and resolved by means of *l*-menthylamine and cinchonine. The *iso*bornyl hydrogen phthalates have $[\alpha]_D$ $\pm 76{\cdot}8°$ in chloroform solution, and when hydrolysed readily yield the pure *iso*borneols, which have $[\alpha]_D$ $\pm 34{\cdot}3°$ in ethyl-alcoholic solution. The identity of Haller's *iso*camphols (obtained by reduction of camphor), which had $[\alpha]_D$ $\pm 32{\cdot}9°$ in ethyl-alcoholic solution, with the inactive *iso*borneol from camphene has long been assumed. The results described may be taken as proof of this, although it is probable that the product obtained from "camphene" contains other substances besides *d*- and *l*-*iso*borneol.

233. "The electrolytic preparation of disulphides. Part I. Dibenzyldisulphide and diethyldisulphide." By Thomas Slater Price and Douglas Frank Twiss.

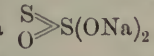
The electrolysis of the alkyl thiosulphates (compare *Proc.*, 1906, **22**, 260), which are used to prepare the disulphides, was originally performed in a beaker, without any diaphragm between the anode and the cathode, and the formation of disulphides was assumed to be due to the decomposition of the discharged anions, according to the equation $2R{\cdot}S_2O_3 = R_2S_2 + 2SO_3$.

Subsequent experiments, however, with divided cells, have proved the formation of disulphide to be due to the reduction of the alkyl thiosulphate anion at the cathode, according to the equation

$$2R{\cdot}S_2O_3' + 2H = R_2S_2 + 2HSO_3'.$$

The best yield of disulphide is obtained by using a low current density, a concentrated solution, and current in excess of that theoretically required; the addition of sodium carbonate or bicarbonate to the electrolyte is also advantageous.

Although the pure alkyl thiosulphate compounds were used in the earlier experiments, it has been found quite satisfactory to electrolyse the mixture obtained by heating together sodium thiosulphate and the organic halide in aqueous-alcoholic solution; a divided cell is then used.

The bearing of the above results on the constitution of sodium thiosulphate was discussed, since Gutmann, in a series of recent papers (*Ber.*, 1905, **38**, 1728 and 3276, &c.), favours the constitutional formula  ${}^{S}_{O}\!\!\gg S(ONa)_2$ in place of the usually accepted formula $SO_2(ONa)(SNa)$. It was shown that the former formula is not satisfactory, and that all Gutmann's results are in accordance with the latter.

234. "The influence of solvents on the rotation of optically active compounds. Part XI. Ethyl tartrate in aliphatic halogen derivatives." By Thomas Stewart Patterson and David Thomson.

The rotation of ethyl tartrate has been determined in methylene chloride, carbon tetrachloride, ethylene chloride, ethylidene chloride, acetylene tetrachloride, bromoform, ethyl bromide, ethylene bromide, acetylene tetrabromide, methyl iodide, methylene iodide, and ethyl iodide at various temperatures and concentrations. The values found were compared with those for molecular solution-volume. To some extent an inverse relationship holds between these variables. In all the solvents under consideration, the rotation of the dissolved ethyl tartrate is depressed below that of the homogeneous ester, whilst, on the other hand, the molecular solution-volume becomes greater than the molecular volume. Amongst the individual data also an inverse proportionality often obtains, but a correlation between the two variables cannot be traced through all the solvents examined, since exceptions are both numerous and important.

235. "The interaction in solution of ferrous sulphate and copper sulphate." By Henry Russell Ellis and William Henry Collier.

When ammonia is added to copper sulphate solution, the distinctive blue coloration is not obtained or is rendered indistinct if ferrous sulphate is present.

If excess of ferrous sulphate is present, no coloration is produced, whilst the iron is precipitated as ferrous and ferric hydroxides; the solution contains cuprous compounds, and a small quantity is present in the precipitate. The production of the ferric hydroxide is brought about by the oxidising action of the compound $CuSO_4,5NH_4OH$, and the amount of oxidation is proportional to the amount of this substance present.

Complete oxidation is brought about when both the copper and ammonia are present in excess.

The authors have been able to oxidise the whole of the iron in a few minutes in the cold by using the proportions $10NH_4OH$, $CuSO_4$, and $\frac{1}{2}FeSO_4$. Solutions of ferrous sulphate, on boiling, become hydrolysed, giving an acid solution.

No action takes place between ferrous sulphate and copper sulphate solutions in the cold, but, on boiling, the copper sulphate slowly oxidises the ferrous hydroxide produced by hydrolysis.

236. "Mercurous hyponitrite." By Edward Divers.

A paper with the above title, by P. C. Rây, published in the August number of the *Transactions*, having been taken as read, opens with the following words: "Mercurous hyponitrite, which has already been obtained in a somewhat impure condition by the author (*Trans.*, 1897, **71**, 348), may be prepared (*a*) by precipitating mercurous nitrate with carefully neutralised sodium hyponitrite made according to Divers' method (*Trans.*, 1899, **75**, 96, 119); (*b*) by precipitating mercuroso-mercuric nitrite (Rây, *Trans.*, 1902, **81**, 644) with the crude alkaline hyponitrite; or (*c*) by precipitating mercurous nitrate with acid potassium hyponitrite (Thum, *Inaug. Dissert.*, 1893)." Any one unacquainted with the facts referred to will hardly get a correct notion of them from this obscure sentence. These facts are (1) that Thum in an unusually brilliant inaugural dissertation on hyponitrous acid gave, in 1893, a description, accompanied by excellent analyses, of the mercurous salt among others; (2) that, in 1897, there appeared a paper by Rây describing, as new, mercurous hyponitrite (in admixture with a mercuric salt) obtained from sodium hyponitrite by adding it to a solution of mercuroso-mercuric nitrite, a solution he had resort to (notwithstanding the complications likely to ensue consequent upon the presence in it of mercuric salt and upon its being a solution of a nitrite) because he supposed that mercurous nitrate would not serve for the purpose, in consequence of the acidity of its solution; and (3) that, beyond this pointless substitution of a solution of one mercurous salt for another, Rây's paper contained nothing new, nothing so good as had been already published, and yet something beneath criticism about a supposed mercuric hyponitrite (see *Trans.*, 1899, **75**, 119).

Rây's recent paper, besides implying that mercurous hyponitrite, prepared by Rây's reagent, has now been obtained free from mercuric salt in some way not even alluded to (the evidence for this being some new analyses, three out of four of which are not a whit better than those of the admittedly impure preparations), contains only the statement that this preparation of Ray's (possibly containing nitrite) cannot be dissolved in nitric acid without immediately yielding metallic mercury, notwithstanding the fact that Thum was able to reprecipitate the salt in a pure state from its solution in nitric acid, as his analysis and description establish, and that the writer (*Trans.*, 1899, **75**, 121) has published experience similar to Thum's, each working with salt of high purity.

237. "Decomposition of mercurous and silver hyponitrites by heat." By Edward Divers.

Rây and Gañguli have not succeeded in giving a definite and consistent interpretation of the results which they have recorded in their recent paper on the decomposition of mercurous and silver hyponitrites by heat (*Trans.*, 1907, **91**, 1397). They have not perceived that these results are impossible as they stand, and must be corrected if they can be. The corrections called for in the case of the silver salt lie well within the limits of errors in the experimental analyses, whilst, in the case of the mercury salt, the justifiable assumption of the presence of nitrite fairly well accounts for numbers otherwise too far from what the pure salt would have given. Had the authors been aware of the imperfect nature of their results, in the case of the mercury salt, they would presumably have deferred publication of them. But, even as published, these results seem capable of such revision and subsequent interpretation as may make them add materially to the knowledge of the decomposition of hyponitrites by heat.

The two hyponitrites examined evidently decompose when heated each in three ways, which are expressed by the following equations. For the mercury salt, these are: $(HgON)_2 = 2Hg + 2NO$ (1); $(HgON)_2 = Hg + HgO + N_2O$ (2); $3(HgON)_2 = 4Hg + (HgNO_3)_2 + 2N_2$ (3). In Rây and Gañguli's mode of procedure, it would seem, on probable calculation, as tabulated below, that 2·96 out of 6·09 parts of the salt will have decomposed according to (1); 2·32 parts according to (2), and 0·81 part according to (3). Or, in percentage numbers, 48·6, 38, and 13·3 according to equations (1), (2), and (3) respectively.

In the case of the silver salt, where we are on much surer ground, two of the equations are just like (1) and (3) for the mercury salt, whilst the other, which only differs from (2) as given for the mercury salt because of the instability of silver oxide, is $(AgON)_2 = 2Ag + O + N_2O$ (2′), the free oxygen of which with 2NO by equation (1) becomes first N_2O_3, let us say, and then nitrite, on contact with the solution of potassium hydroxide, as Rây and Gañguli explain. Ultimately, therefore, the second equation becomes $2(AgON)_2 = 4Ag + N_2O_3 + N_2O$, but, for the sake of comparison with the mercury salt, it seems better to use the equation showing free oxygen and count the nitrite nitrogen along with that as nitric oxide. The conclusion that must be come to, after inspecting the tables, will be that Rây and Gañguli had really 7·84 (= 6·58 + 1·26) parts out of 10·15 of the silver salt decomposed according to equation (1); 1·26 parts according to (2′), and 1·05 parts according to (3) (Ag being read for Hg). Or, 83, 13·3, and 3·7 per cent. respectively according to equations (1), (2′), and (3). Reference to the authors' paper will show that they have themselves put forward equations (1) and (2), that they reject (3), and that they suggest others which, it may here be said, could not be worked in with their results in any likely way.

The interpretation, here submitted, of the effects of heating the two hyponitrites is derived from the numbers exhibited in the subjoined tables.

Distribution of the Nitrogen and Oxygen of Mercurous Hyponitrite in the Products of its Decomposition by Heat.

Product.	N_2.	N_2O.	NO.	N_2O_3.	NO_3.	HgO.	Total.	Theory.
N found ...	0·54	2·32	2·53	0·24	0·48	—	6·11	6·09
O ,, ...	—	1·33	2·89	0·41	1·65	1·19 *	7·47	6·96
N calc.	0·54	2·32	2·96	—	0·27	—	6·09	6·09
O ,, ...	—	1·33	3·38	—	0·92	1·33	6·96	6·96

Distribution of the Nitrogen and Oxygen of Silver Hyponitrite in the Products of its Decomposition by Heat.

Product.	N_2.	N_2O.	NO.	N_2O_3.	NO_3.	Total.	Theory.
N found	1·06	1·15	6·58	1·26	0·35	10·40	10·15
O ,, ...	—	0·66	7·52	2·16	1·20	11·54	11·60
N calc.........	0·70	1·26	6·58	1·26	0·35	10·15	10·15
O ,, ...	—	0·72	7·52	2·16	1·20	11·60	11·60

* See note on page 1400 in Rây and Gañguli's paper.

The numbers in the first line of each table are the mean numbers of those given by the authors for the nitrogen of the several products as parts per cent. of the salt. The column headed "N_2O_3" shows the nitrogen of the nitrite in the potassium hydroxide solution they made use of. The column "NO_3" shows the nitrogen, obtained or calculated, as mercurous or silver nitrate. In the case of the mercurous hyponitrite, the distribution of the nitrogen as nitrite and nitrate has been assumed to have been in all three experiments as 1 : 2, in agreement with what it was found to be in the only reported experiment in which it was determined by the authors.

The numbers in the second line of each table are for the oxygen corresponding with those for the nitrogen in the first line. Their sum, in the case of the mercury salt, is much in excess of the percentage of oxygen in mercurous hyponitrite. Since the mercurous hyponitrite, which the authors made use of, had been prepared from mercuroso-mercuric nitrite, the excess of oxygen found may be attributed to the presence of nitrite in the salt as prepared. The column headed, HgO, shows the oxygen left as mercuric oxide as being necessarily equal to that in the nitrous oxide, less (in the second line) by one-third of that as nitrous anhydride (1·33—0·14 = 1·19).

The numbers in the third and fourth lines of each table have been calculated in accordance with the equations already given, and in such a way as to make them differ the least possible from the numbers furnished by the experiments, under the necessary condition that their respective sums shall be identical with the percentages of nitrogen and oxygen in the pure mercurous and silver hyponitrites. In the case of the mercury salt, it has been assumed that, when free from nitrite, mercurous hyponitrite yields no red fumes and very little nitrate, which is in accordance with the writer's experience, referred to by the authors. The numbers for the silver salt have been altered to make the free nitrogen equal to only twice that found as nitrate; that found as nitrous oxide to be equal to that as nitrite, and total nitrogen and oxygen to be equal respectively to the percentages of these elements in the pure salt.

A noticeable point in Rây and Gañguli's paper is their experience of the conversion by heat of nearly one-eighth of silver hyponitrite into silver, nitrous oxide, and oxygen. The writer did not observe the presence of any nitrous oxide in his experiments (*Trans.*, 1899, **75**, 108). Nor has any other worker recorded the fact of having done so. On the evidence afforded by Rây and Gañguli's experiments, the writer is prepared to admit that nitrous oxide may never be absent altogether in the products of the decomposition of silver hyponitrite by heat. As to the matter of quantity of nitrous oxide, the details of their experiments and his are sufficiently different to account for the fact of their obtaining so much of it and he so little as to pass unnoticed. The salt they used contained, they think, impurities enough to be mentioned, and began to decompose very slowly at 100°, and at 140° suffered rapid decomposition. It had been dried cold over sulphuric acid under reduced pressure, but was heated to decomposition in a tube between which and the Sprengel pump a tube of "aqueous potash" intervened. A very little moisture would have given a lower temperature of decomposition, and caused free generation of nitrous oxide. In the writer's experiments, salt of high purity, dried finally in a Sprengel vacuum at 98°, was used. Thus dried, the pure salt hardly begins to decompose at 140°, and is not in free decomposition much, if at all, below 160°. It would seem highly probable from the difference in the effects of heat that the generation of nitrous oxide is largely, if not wholly, a matter of hydrolysis.

Another point worthy of attention in Rây and Gañguli's paper is their contention that nitric peroxide is a secondary product arising out of the union of nitric oxide with the oxygen set free along with nitrous oxide. The writer thinks this to be highly probable. His position as to nitric oxide and nitric peroxide being primary products has been that for twenty years, he held, without proof, that nitric oxide was the primary product which produced red fumes by contact with air. Thum proved, in 1893, that out of contact with air the salt still gave nitric peroxide when heated. The writer then examined the matter himself for the first time and found Thum right. Having ascertained that nitric peroxide and silver gave silver nitrate and nitric oxide, he concluded, in 1899, that nitric peroxide was the primary product and nitric oxide secondary. Now he returns to his first view and agrees with Rây and Gañguli that nitric oxide is the primary product, at the same time being certain that it is also reproduced by reduction of the nitric peroxide by silver.

It is much to be desired that Rây and Gañguli would repeat their experiments, making use of pure mercurous hyponitrite prepared by Thum and the writer's process, and of the driest pure silver hyponitrite, in their apparatus supplied with some solid potassium hydroxide in the near end of their absorption tube.

238. "Cupric nitrite." By Edward Divers.

A paper appeared not long ago in the *Transactions* (1907, 91, 1405) on cupric nitrite, in which Rây sets forth his observations on what he regards as being the atmospheric oxidation and autoxidation of this salt. Now nitrites, as such, do not oxidise and, in the cases where they do not hydrolyse in water, they are stable in solution. (The passage of cobaltous into cobaltic nitrite is, of course, no exception to the statement.) What Rây has occupied himself with is simply the oxidation of nitrous acid, not cupric nitrite, in aqueous solution. For when a cupric salt is dissolved in water, it is always hydrolysed to some extent, as is shown by its acid reaction and other facts. Nitrous acid in aqueous solution becomes nitric acid and nitric oxide, and nitric oxide oxidises in the air. When it is added that nitric acid decomposes some of the cupric nitrite to form nitrate together with more free nitrous acid, there seems to be no more to be said. As to the oxidation of cupric nitrite, as such, we are left as we were, without any evidence whatever of its occurrence.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bunge, *Gustav von.* Text-book of organic chemistry for medical students. Translated, with additions, by *R. H. Aders* **Plimmer.** pp. ix + 260. London 1907. (*Recd.* 8/11/07.) From the Translator.

Duparc, *Louis*, and **Monnier,** *Alfred.* Traité de chimie analytique qualitative. Suivi de tables systématiques pour l'analyse minérale. pp. viii + 374. Genève 1908. (*Recd.* 16/11/07.)
From the Publisher: Librairie Kündig.

Fränkel, *Sigmund.* Descriptive Biochemie mit besonderer Berücksichtigung der chemischen Arbeitsmethoden. pp. xi + 640. Wiesbaden 1907. (*Recd.* 16/11/07.)
From the Publisher: J. F. Bergmann.

Haller, *Albin*, and **Girard**, *Charles* [and others]. Memento du chimiste (ancien Agenda du chimiste). pp. xx + 758. Paris 1907. (*Recd.* 16/11/07.)

From the Publishers: Messrs. H. Dunod and E. Pinat.

Hanneke, *P.* Photographisches Rezept-Taschenbuch. pp. iv + 175. Berlin 1907. (*Recd.* 16/11/07.)

From the Publisher: Gustav Schmidt.

Manchester. *Rivers Department.* Annual Report for the year ending March 27th, 1907. (*Recd.* 1/11/07.)

From the Rivers Committee.

II. *By Purchase.*

Blyth, *Alexander Wynter*, and **Blyth**, *Meredith Wynter.* Poisons: their effects and detection. Fourth edition. pp. xxxii + 772. London 1906. (*Recd.* 26/6/7.)

Handbuch der anorganischen Chemie. Edited by *Richard* **Abegg.** Vol III, part 3. pp. xiv + 876. Leipzig 1907. (*Reference.*)

Kauffmann, *Hugo.* Die Auxochrome. (Sammlung, Vol. XII.) Stuttgart 1907. (*Recd.* 9/8/7.)

Le Blanc, *Max.* Text-book of electro-chemistry. Translated from the fourth enlarged German edition by *Willis R.* **Whitney** and *John W.* **Brown.** pp. xiv + 338. ill. New York 1907. (*Recd.* 26/6/7.)

Nernst, *Walther.* Experimental and theoretical applications of thermodynamics to chemistry. pp. x + 123. ill. London 1907. (*Recd.* 2/7/7.)

Oswald, *Adolf.* Lehrbuch der chemischen Pathologie. pp. vi + 614. Leipzig 1907. (*Recd.* 20/11/07.)

Post, *Julius.* Chemisch-technische Analyse. Handbuch der analytischen Untersuchungen zur Beaufsichtigung chemischer Betriebe. Edited by *Bernhard* **Neumann.** Vol. I, parts 2 and 3. Vol. II, part 2. pp. 307, 326, 350. ill. Braunschweig 1907. (*Recd.* 1/10/7.)

Schwalbe, *Carl G.* Neuere Färbetheorien. (Sammlung, Vol. XII.) Stuttgart 1907. (*Recd.* 9/8/7.)

Stange, *Albert.* Die Zeitalter der Chemie in Wort und Bild. pp. xiii + 528. ill. Leipzig 1907. (*Recd.* 20/11/07.)

Thausing, *Julius E.* Die Theorie und Praxis der Malzbereitung und Bierfabrikation. 6th edition. pp. xxviii + 1280, and atlas. Leipzig 1907. (*Recd.* 20/11/07.)

III. *Pamphlets.*

Albo, *Giacomo.* Sui principii alcaloidici dei semi di tabacco. (From *Bull. Soc. bot. ital.*, 1902.)

Albo, *Giacomo.* Sul significato fisiologico della nicotina nelle piante di tabacco. 1901.

—— Ancora sulla fisiologia della nicotina nelle piante di tabacco. (From *Bull. Soc. bot. ital.*, 1907.)

Andrews, *E. C.*, and **Mingaye**, *J. C. H.* The geology of the New England Plateau, with special reference to the granites of Northern New England. Part IV. Petrology. (From the *Records Geol. Sur. N. S. Wales*, 8, 1907.)

Essex Education Committee. The Essex Field Experiments, 1906. Report by *B. W.* **Bull** and *V. H.* **Kirkham.** Chelmsford 1907.

—— Market-day Lectures, 1905—6, being reports of addresses to farmers, delivered at Chelmsford and Colchester during the winter months. Chelmsford [1907].

—— Notes on agricultural analyses, 1903—1906. Compiled by *V. H.* **Kirkham.** Chelmsford [1907].

Herty, *Charles H.* Industrial and scientific aspects of the pine and its products. (From the *Chemical Engineer*, 1907.)

Hooper, *David.* Well-waters from the Hadhramaut, Arabia. (From the *J. and Proc., Asiatic Soc. of Bengal*, 3, 1907.)

—— The fats of *Garcinia* species. (From the *J. and Proc., Asiatic Soc. of Bengal*, 3, 1907.)

Leather, *J. Walter.* The pot-culture house at the Agricultural Research Institute, Pusa. (From the *Mem. Dept. Agric. India*, 1, 1907.)

—— The composition of the oil-seeds of India. (From the *Mem. Dept. Agric. India*, 1, 1907.)

—— Experiments on the availability of phosphates and potash in soils. (From the *Mem. Dept. Agric. India*, 1, 1907.)

Midland Agricultural and Dairy College. Reports on experiments with crops and stock, carried out . . . in the year 1906—1907.

Mingaye, *J. C. A.* Notes on analyses and tests of Japanese coals. (From the *Records Geol. Sur. N. S. Wales*, 8, 1907.)

Oshima, *Kintaro.* On the constituents of rush-pith. (From the *J. Sapporo Agric. Coll., Japan*, 2, 1906.)

Plimmer, *R. H. Aders.* The work of Emil Fischer and his school on the chemistry of the proteins. (From *Science Progress*, 1907.)

Power, *Frederick B.*, and **Tutin**, *Frank.* Chemical examination of Grindelia. (From the *Proc. Amer. Pharm. Assoc.*, 1905.)

Reade, *J. Mellard*, and **Holland**, *Philip.* Analyses of Ludlow rocks. (From the *Proc. Liverpool Geol. Soc.*, 1906—1907.)

Richards, *Theodore William*, **Staehler**, *A.*, **Forbes**, *G. S.*, **Mueller**, *E.*, and **Jones**, *G.* Further researches concerning atomic weights of potassium, silver, chlorine, bromine, nitrogen, and sulphur. *Carnegie Institution of Washington, Publication No.* 69, 1907.

Richards, *Theodore William*, **Stull**, *W. N.*, **Brink**, *F. N.*, and **Bonnet**, *F.* The compressibilities of the elements and their periodic relations. *Carnegie Institution of Washington, Publication No.* 76, 1907.

Waidner, *C. W.*, and **Burgess**, *G. K.* Preliminary measurements on temperature and selective radiation of incandescent lamps. (From the *Bull. Bureau of Standards, Washington*, **2**, 1906.)

—— Radiation from, and melting points of, palladium and platinum. (From the *Bull. Bureau of Standards, Washington*, **3**, 1907.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 9th, 1907.

All persons who received grants in December, 1906, or in December of any previous year whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Monday, December 2nd, next.

At the next Ordinary Meeting, on **Thursday**, December 5th, 1907, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :

"The affinity constants of bases as determined by the aid of methyl-orange." (Preliminary note.) By V. H. Veley.

"The velocity of reduction of the oxides of lead, cadmium, and bismuth by carbon monoxide, and the existence of the suboxides of these metals." By F. J. Brislee.

"The relation between unsaturation and optical activity. Part I. The menthyl and bornyl esters of β-phenylpropionic, cinnamic, and phenylpropiolic acids." By T. P. Hilditch.

"The constituents of the essential oil of nutmeg." By F. B. Power and A. H. Salway.

"Methyl ethers of some hydroxyanthraquinones." By A. G. Perkin.

"The colouring matters of the stilbene group. Part IV. The action of caustic alkalis on paranitrotoluene and its derivatives." By A. G. Green, A. H. Davies, and R. S. Horsfall.

"The replacement of alkyl radicles by methyl in substituted ammonium compounds." By H. O. Jones and J. R. Hill.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 5th, 1907.

Banks, Arthur John,

61, Lawton Road, Waterloo, Liverpool.

Research Chemist. Studied Theoretical and Practical Chemistry and Microscopy in the laboratory of the late A. Norman Tate, F.I.C., F.C.S., 7–11, Hackins Hey, Liverpool (1881-2-3-4); have since been continuously engaged in analytical and research work; the past 4½ years (1902–7) have been devoted to an enquiry into the factors governing the "strength and other qualities" of wheat. Contributions: "Note on the Laboratory Drying Oven," *Chem. News*, **58**, 54 (1888). Note on "A New Chemical Test for Strength in Wheat," *Nature*, **75**, 460—1 (1907). Collaborated with F. W. Fellowes in the preparation of the following papers, viz.: (1) "Some of the Micro-organisms Causing the Diseases of Beer," *Trans., North of England Institute of Technical Brewing*, **3**, 107—136 (1894), on p. 129 reference is made to my apparatus for cultivating anaërobic organisms by means of plate growths; (2) "Facts, Fancies, and Fallacies," *Trans. of the Federated Institutes of Brewing*, **2**, 247—272 (1896). Further reference to my work was made by Alf. Jörgensen in his paper "Hansen's System of Pure Yeast Culture in English Top Fermentation," *Trans., Institute of Brewing*, **7**, 235, 246 (1894).

Horace T. Brown. W. J. Cousins.
Arthur R. Ling. *Francis Henry Tate.*
George T. Holloway.

Barnett, Edward de Barry,

40, Queensborough Terrace, Hyde Park, W.

Research Student, University College, London.

William Ramsay. J. Norman Collie.
R. W. Gray. Edward C. Cyril Baly.
B. D. Porritt.

Bell, John Forbes,

Craigmillar, Edinburgh.

Brewer's Chemist. Bronze Medallist and First Class Honours Certificate in Brewing, City and London Guilds Institute. Studied Chemistry under Mr. John Hunter, F.I.C., F.C.S., Analyst for County of Midlothian, &c. Member of Committee of the Scottish Section of the Institute of Brewing.

John Hunter.
Matthew J. Cannon.
John S. Ford.
John M. Guthrie.
John Doull.

Buckney, Frank,

51, Highbury Park, London, N.

Demonstrator in Cambridge University Laboratory. Honours in Chemistry, Tripos Parts I. and II. Cambridge. Original research: "A New Optically Active Tetrahydroquinoline Compound," delivered before Cambridge Philosophical Society.

F. H. Neville.
W. J. Sell.
J. Parkin.
H. O. Jones.
F. E. E. Lamplough.
F. W. Dootson.

Callan, Thomas,

22, Church Street, Egremont, Cheshire,

Research Chemist. Assistant Chemist to Messrs. J. Woolley, Sons, and Co., Manchester, 1900–3. B.Sc., Victoria University of Manchester, with First Class Honours in Chemistry, 1906. Am now Research Assistant to Prof. J. Campbell Brown, Liverpool University.

J. Campbell Brown.
A. W. Titherley.
D. L. Chapman.
H. B. Dixon.
J. F. Thorpe.

Caton, Frederic William,

6, King Street, Snow Hill, E.C.

Research Chemist at Wellcome Chemical Research Laboratories. B.A. (Oxford), B.Sc. (London). Have spent one year in Research in Mr. J. E. Marsh's Laboratories at Oxford.

Frederick B. Power.
John Watts.
Allan F. Walden.
J. E. Marsh.
W. W. Fisher.
R. de J. Fleming-Struthers.

Crisp, George Hugh,

62, Gainsboro' Road, Crewe.

Chemistry Master at the Cheshire County School, Crewe. B.A.

(Oxon.); Third Class Honours in Natural Science (main subject: Chemistry). Wishes to keep in touch with recent researches in Chemistry.

N. V. Sidgwick. H. B. Hartley.
A. F. Walden. A. Angel.
D. H. Nagel. *H. Brereton Baker.*

Day, Edward Joseph,
Dorchester.

Doctor of Medicine (Durham University). Medical Officer of Health (Rural and Urban), Dorchester Borough and Dorchester Rural Sanitary District. Over twenty years both appointments. M.D. (Durham); M.R.C.S. (England); L.S.A. (London). Late Public Analyst for Boroughs of Dorchester, Bridport, and Lyme Regis.

John Hunter. Fredk. Hudson-Cox.
A. H. M. Muter. Edward Russell.
Chas. J. Waterfall.

Dupré, Frederick Harold,
Mount Edgcumbe, Sutton, Surrey. Business address: 2, Edinburgh Mansions, Howick Place, S.W.

Analytical and Consulting Chemist. Ten years Assistant to the late Dr. A. Dupré, F.R.S. At present, jointly with my brother, P. V. Dupré, Acting Chemical Adviser to the Explosives Department of the Home Office.

Otto Hehner. Bernard Dyer.
W. J. Dibdin. Henry E. Armstrong.
Gerald T. Moody.

Dupré, Percy Vivian,
Mount Edgcumbe, Sutton, Surrey.

Analytical and Consulting Chemist. Associate of the City and Guilds of London Institute. Eight years' work under the late Dr. Dupré, F.R.S. Have had two papers published in the *Analyst* (Aug., 1905, and July, 1906). Acting Chemical Adviser to the Explosives Department of the Home Office in conjunction with my brother.

Otto Hehner. Bernard Dyer.
W. J. Dibdin. Henry E. Armstrong.
Gerald T. Moody.

Dutton, Francis Bridger,
Birch Hall, Windlesham, Surrey.

Student in Chemistry, Oxford, Magdalen College.

A. F. Walden. D. H. Nagel.
N. V. Sidgwick. T. S. Moore.
H. B. Hartley.

Fawcitt, Claude Scott,

Darlington, England, and Shimoga, S.M. Ry., India.

Analytical Chemist. Undergraduate of Durham University. Seven years in laboratory of Messrs. J. and H. S. Pattinson, Newcastle-on-Tyne. Three years Chemist at Messrs. The Vizianagram Mining Coy.'s Manganese Mines, and at present Analyst to The Mysore Manganese Coy., Ltd.

A. W. Comber.
John Pattinson.
J. T. Dunn.
P. Phillips Bedson.
F. C. Garrett.

Greenough, Thomas Rigby,

Beechwood, Leigh, Lancashire.

Graduate of University of Cambridge (Natural Science Tripos, 1907). Analytical Chemist under Sir Charles Cameron, Dublin. Worked three years in Caius College Laboratory, Cambridge, under M. M. Pattison Muir.

M. M. Pattison Muir.
W. H. Leek.
Charles T. Heycock.
Percy Bean.
Frank Scudder.
Robert Pettigrew.

Hay, William,

Holton House, Beverley Road, Hull.

Student in the Research Laboratory of the Pharmaceutical Society. "Minor" and "Major" examinations of the Pharmaceutical Society.

Arthur W. Crossley.
E. Towyn Jones.
F. Filmer De Morgan.
W. Palmer Wynne.
M. O. Forster.

Hutchinson, William Doge,

Lythmore, Tennyson Road, Harpenden, Herts.

Engaged in Research at Rothamsted Experimental Station. Second Class Honours in Chemistry at Oxford.

A. D. Hall.
N. H. J. Miller.
D. H. Nagel.
H. B. Hartley.
R. T. Lattey.

Ingham, Harry,

26, Hamilton St. Bury, Lancs.

Lecturer at the Technical School, Bury. Master of Science (Vict.). Contributed to the "Transactions of the C.S., 1907, Vol. **91**," in conjunction with Dr. J. F. Thorpe and Dr. E. F. J. Atkinson, a paper on the "Formation and Reactions of Imino-compounds. Pt. III." I wish to keep in touch with the progress of Chemical Research.

W. H. Perkin, jun.
J. F. Thorpe.
Norman Smith.
J. C. Cain.
William Dixon.

Jones, Benjamin Owen,

Boksburg, Transvaal.

Chemist (M.P.S., Gt. Britain). Member of the Legislative Assembly, Transvaal. Member of the Transvaal Pharmacy Board (Government Nominee). Examiner in Pharmacy to above Board. Member and Vice-Chairman of Rand Provisional Joint Committee (Hospitals) and Chairman of East Rand Hospitals (Witwatersrand).

M. Carteighe.
J. Rymer Young.
Peter MacEwan.
John C. Hewlett.
E. J. Millard.

Kaye, John,

Westerfield, Perth.

Research Chemist (on Glass in N.B. Glass Works, Perth). M.A., B.Sc. (Glasgow) in Pure Science. Chemistry taken both in First and Final Examinations. Acted as Demonstrator in Senior Laboratory (Glasgow University). Eighteen months' research on "Optically Active Compounds." Two papers published on "Optical Superposition," *Trans. of Chem. Soc.*, 1906, Vol. **89**; 1907, Vol. **91**.

T. S. Patterson.
Frederick Soddy.
Charles E. Fawsitt.
Thomas Gray.
John Ferguson.

Marsden, Herbert,

Bramford, Ipswich.

Chemist. B.Sc., Manchester. Assisted Prof. Kipping during the past 12 months in his work on "Organic Silicon Compounds." Chemist at Messrs. Packard & Co.'s Agricultural Works, Ipswich.

Harold B. Dixon.
F. Stanley Kipping.
R. M. Caven.
W. H. Perkin, jun.
J. L. Simonsen.
Francis Jones.

Marshall, Hubert Frederick Sankey,

High Street, Burwell, Cambs.

Analyst. Pupil to E. M. Chaplin, Esq., Ph.D., two years. Student Wakefield and Glo'ster Technical Schools, three years. Junior Analyst to Messrs. Stephenson's, Ltd., Cement Works, Burwell. Now Chemist-in-Charge to Messrs. Stephenson.

Edward M. Chaplin.
Robert Stephenson.
Jack V. J. Hayman.
George Embrey.
J. M. Collett.
Robert J. Caldwell.

Martin, Gerald Hargrave,

Delce, Park Rd., Wallington, Surrey.

Wholesale Optician's Assistant. Chemical Student, Birkbeck College.

Alex. McKenzie.
W. G. Tonner.
George W. Clough.
Henry Wren.
H. F. C. Goltz.

Moore, John Edward Langford,

Walton Cottage, Loughboro' Park, S.W.

Head Dispenser to St. Bartholomew's Hospital, E.C. Teacher of Practical Pharmacy and Demonstrator in Materia Medica to St. Bartholomew's Hospital Medical School. Member of the Pharmaceutical Society. My desire for Fellowship arises from my wish to have access to the Society's Library and Literature and to keep myself in touch with advanced chemical knowledge.

F. D. Chattaway.
W. H. Hurtley.
Kenneth S. Caldwell.
J. A. Ormerod.
W. L. Howie.
W. J. Russell.

Mummery, Charles Samuel,

Christ's Hospital, West Horsham.

Undergraduate of London University, and at present engaged in advanced experimental work in Chemistry. Is desirous of being in a position to attend the Scientific Meetings of the Society, and also of receiving the Society's Journal and Proceedings.

Henry E. Armstrong.
Gerald T. Moody.
T. H. Boardman.
Chas. E. Browne.
W. A. Davis.
William Robertson.

Saunders, George Joseph,

School of Mines, Charters Towers, Queensland, Australia.

Demonstrator and Assistant Lecturer in Chemistry, Assaying, and Metallurgy, School of Mines, Charters Towers, Queensland. Three years Student in Chemical and Metallurgical Laboratories, University of Sydney, N.S.W. Graduated as B.E. (Mining and Metallurgy), 1904, Syd. Univ. Eight months Assaying and Manager of Cyanide Works, Nil Desperandum Gold Mine, Forbes, N.S.W. Nine months Assaying, Mt. Eurow Copper Mine, N.S.W. One month Assaying, North Lachlan Gold Mine, Forbes, N.S.W.

J. A. Schofield.
Basil Turner.
Charles Walker.
A. Liversidge.
George Harker.

Smith, Robert Harry,

Apsley House, Priory Road, Sheffield.

Undertaking private analysis and research. Science Teacher, holding South Kensington (Science and Art Department) Certificates in Inorganic and Organic Chemistry. Trained at the Royal College of Chemistry, London.

Frank Clowes. G. T. W. Newsholme.
W. Gowland. *J. H. Coste.*
Wm. Jno. Livingston.

Stobie, Harold Ramsay,

"Clovelly," Craighall Gardens, Edinburgh.

Analytical Chemist. Certificates in Physics and Chemistry (Part I) of the Heriot-Watt College, Edinburgh. Certificate for the complete course of Chemistry and Allied Subjects of the Royal College of Science, Kensington, S.W.

James C. Philip. H. E. Fierz.
M. O. Forster. G. T. Morgan.
Chapman Jones.

Thomas, Frederick, B.Sc.,

29, Fairhaven Road, St. Anne's-on-the-Sea, Lancs.

Assistant Research Chemist. Hons. in Chemistry, University of Manchester, 1906. Research Student till March, 1907. Joint author, with Drs. Bentley, Friedl, and Weizmann, of "Derivatives of Naphthacenequinone" (*Trans.*, 1907, **91**, 411). Since March, 1907, Research Assistant to Messrs. A. G. Perkin and W. P. Bloxam at Leeds University for Research on Indigo under the Government of India.

H. B. Dixon. Norman Smith.
W. H. Perkin, jun. A. G. Green.
J. F. Thorpe. A. G. Perkin.
W. P. Bloxam.

Timpany, Harold Munkman,

St. Winifrede's Gardens, Shrewsbury.

Principal, Technical Schools, Shrewsbury. M.Sc. (Vict.). Principal of, and Lecturer in Chemistry at, Shrewsbury Technical Schools. Author of following School Text-Books: "Arithmetic of Chemistry and Physics" (Blackie); "Qualitative Analysis Tables with Equations and Notes" (Blackwood).

H. B. Dixon. Norman Smith.
G. H. Bailey. J. F. Thorpe.
D. L. Chapman.

son, George Arthur,

7, Roseneath Villas, Cork.

Chemistry Lecturer, Co. Cork Technical Instruction Committee. Consulting Chemist. Associate of Royal College of Science, Faculty of Applied Chemistry. Teacher of Chemistry, Cork Grammar School.

W. N. Hartley.
H. M. Atkinson.
James H. Pollok.
Jno. Northing.
A. J. O'Farrelly.
P. Bertram Foy.

Wechsler, Marcus,

136, Sinclair Road, Kensington, W.

Analytical Chemist. D.Sc., Grenoble (France). Contribution to "The Study of Acenaphthene" (Dissertation, Grenoble, December, 1906). Contribution to Th. Zincke's "Method for Condensing Hydrocarbons with Benzylchloride" (Dissertation, Grenoble, December, 1906). "The Constitution of Benzylacenaphthene" (*Bull. Soc. Chim.*, (3^e) T. 31–32, p. 922). At present engaged on Analytical and Research Work at Gillman and Spencer, London.

Alex. McKenzie.
G. W. Clough.
Henry Wren.
H. B. P. Humphries.
W. G. Tonner.

Wheeler, Edward,

113, Highbury Quadrant, London, N.

Assistant in Chemical Dept., at Central Technical College, South Kensington. Associate of the City and Guilds Institute (A.C.G.I.) in Chemical Dept.

Henry E. Armstrong.
William A. Davis.
William Robertson.
Edward Horton.
T. Martin Lowry.
John Vargas Eyre.
Walter H. Glover.

Whymper, Robert,

St. Clare, St. Mary's Road, Ditton Hill, Surrey.

Research Chemist. Associate of City and Guilds Institute. Salters' Coy.'s Research Fellow.

Henry E. Armstrong.
Robert J. Caldwell.
Wm. Robertson
William A. Davis.
John Vargas Eyre.
Edward Horton.

Williams, Percy,

c/o The Wilhelmina Co., Pontianak, Dutch West Borneo.

Chemist. B.Sc., London. "The Borides of Calcium, Strontium, and Barium," in collaboration with H. Moissan (*C.R.*, 1897). Two papers on "Double Carbides" (*C.R.*, 1898). "The Transition Point of Schömt," in collaboration with Prof. van't Hoff. "The Hydrates of

Manganese Chloride," in collaboration with H. M. Dawson (*Zeit. Phy. Chem.*, 1899). "A New Method for the Determination of Transition Points," in collaboration with H. M. Dawson (*Amer. Jour. Phy. Chem.*, 1899). 1900–1906, Chemist to the "British Uralite" Company, Higham, Kent. 1906, Chemist to the "Wilhelmina" Co., Pontianak, Dutch West Borneo.

William Ramsay. J. Norman Collie.
Frank Collingridge. N. T. M. Wilsmore.
G. Nevill Huntly. Samuel Smiles.
Noël Heaton.

Willott, David, B.Sc.,

Rosedale, Thorncroft Road, Sutton, Surrey.

Science Lecturer. Was a student of Chemistry at the Manchester Technical School, and afterwards at the South-Western Polytechnic, Chelsea. Have been a lecturer in Chemistry for 15 years at the Swansea Municipal Technical School, the Sutton Technical School, &c. Took the B.Sc. Degree of the London University with Honours in Chemistry. I wish to become a Fellow of the Chemical Society that I may keep in touch with current chemical literature.

F. H. Lowe. J. C. Crocker.
Sidney Skinner, *John Wilson.*
J. L. White.

Wilson, William John,

28, Windmill Street, Gravesend, Kent.

Analytical Chemist. Associate of the City and Guilds of London Institute. Assistant Chemist to the Associated Portland Cement Manufacturers (1900), Ltd.

Henry E. Armstrong. Edward Horton.
William Robertson. W. A. Davis.
Gerald T. Moody.

Wootton, Hubert Arthur, B.A. (Cantab.), B.Sc. (Lond.).

20, Great College Street, Westminster.

Science Master in Westminster School. Formerly Assistant Demonstrator in the University Chemical Laboratory, Cambridge. Formerly Assistant Lecturer of Clare College, Cambridge.

W. J. Sell. H. J. H. Fenton.
T. B. Wood. H. O. Jones.
H. Brereton Baker.

The following certificates have been authorised by the Council for presentation to Ballot, under Bye-law I (3):

Croghan, Edward Henry,

c/o Messrs. H. Eckstein & Co., P.O. Box 149, Johannesburg.

Analytical Chemist. Matriculation and full chemical course at the South African College, Cape Town, from 1899—1902. Also Laboratory Assistant to Professor Hohn for 2 years. 1903—1906, Assistant Analytical Chemist to Messrs. H. Eckstein & Co. At present, Chief Chemist to this firm. I have written *two* papers for the Chemical, Metallurgical, and Mining Society of South Africa, and *one* for the British Association at their meeting in South Africa. I wish to keep in touch with Chemical progress.

James Moir.	J. McCrae.

Foreman, Charles Thomas,

Jamalpur, E.I.R., Bengal, India.

(Chief) Chemist and Metallurgist to the East Indian Railway. From March, 1887, to Dec., 1899, Assistant Chemist to the Consett Iron and Steel Co., Durham.

Paul Brühl.	*W. R. Criper.*
David Hooper.	*W. T. Grice.*

Schober, William Bush,

Lehigh University, South Bethlehem, Pa., U.S.A.

Professor of Chemistry. B.Sci., 1886; A.M., 1890, St. John's College, Annapolis, Maryland. Ph.D., Johns Hopkins University, 1892. Instructor in Chemistry, Lehigh University, 1892—1902; Assistant Professor, 1902—1906; Professor, 1906.

Ira Remsen.	Chas. H. Herty.
Chas. B. Dudley.	*Chas. Baskerville.*

Marston T. Bogert.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 13/12/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 333.

Thursday, December 5th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

The PRESIDENT announced that Professor Wislicenus, of Tübingen, was arranging to establish a memorial to the late Professor Lothar Meyer.

Certificates were read for the first time in favour of Messrs.:

Edward Philip Andreae, Ph.D., Crestalba, Champion Hill, S.E.
Marie Joseph Arsène Braun, Ph.D., 5, Aspinall Road, Brockley, S.E.
William Henry Collier, 13, Powis Gardens, Bayswater, W.
John Maxwell Heron, North House, Manningtree, Essex.
Thomas Percy Hilditch, 4, Park Hall Place, E. Finchley, N.
Capet Darcy Morewood, Ferndale, Frodingham, Doncaster.
Alfred William Oke, B.A., LL.M., 32, Denmark Villas Hove.
Douglas Robert Pinnoik, 31, The Gardens, E. Dulwich, S.E.
Arthur Robert Runeekles, 68, Kyrle Road, New Wandsworth, S.W.
Adolph Octavius Trechmann, The Old Palace, Rochester.
Alfred Wade, Government Pharmacist, Fiji.
Herbert Edmeston Watson, B.Sc., Tringhurst, Cranes Park, Surbiton.
Harry Percy Wilson, 3, Audley Road, Colchester.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

Arthur John Banks.
Edward De Barry Barnett.
John Forbes Bell.
Frank Buckney, B.A.
Thomas Callan, B.Sc.
Frederic William Caton, B.A., B.Sc.
George Hugh Crisp, B.A.
Edward Henry Croghan.
Edward Joseph Day, M.D., M.R.C.S.
Frederick Harold Dupré.
Percy Vivian Dupré.
Francis Bridger Dutton.
Claude Scott Fawcitt.
Charles Thomas Foreman.
Thomas Rigby Greenough, B.A.
William Hay.
William Doge Hutchinson, B.A.
Harry Ingham, M.Sc.
Benjamin Owen Jones.
John Kaye, M.A., B.Sc.
Herbert Marsden, B.Sc.
Hubert Frederick Sankey Marshall.
Gerald Hargrave Martin.
John Edward Langford Moore.
Charles Samuel Mummery.
George Joseph Saunders, B.E.
William Bush Schober, A.M., B.Sci., Ph.D.
Robert Harry Smith.
Harold Ramsay Stobie.
Frederick Thomas, B.Sc.
Harold Munkman Timpany, M.Sc.
George Arthur Watson.
Marcus Wechsler, D.Sc.
Edward Wheeler.
Robert Whymper,
Percy Williams, B.Sc.
David Willott, B.Sc.
William John Wilson.
Hubert Arthur Wootton, B.A., B.Sc.

Of the following papers, those marked * were read :—

*239. "The affinity constants of bases as determined by the aid of methyl-orange." (Preliminary note.) By Victor Herbert Veley.

In a former communication (*Trans.*, 1907, **91**, 155), it was shown that if x be the units of 0·1 c.c. hydrochloric acid added to an $N/40,000$ solution of methyl-orange, and y be the heights of a variable tintometer column, expressed in centimetres, required to produce the required match in tint, then $y = kx - b$. In this expression, k is the essential factor (or constant) of y in terms of x and b is accidental.

Certain values of k were obtained for hydrochloric acid, as also for the hydrochlorides of some aminocarboxylic acids.

As it was thought that such values might serve to determine the amount of free hydrochloric acid, and hence the degree of hydrolysis of the hydrochlorides of bases, preliminary experiments were made without any special care with a sample of *m*-phenylenediamine hydrochloride. It was then found with aqueous solutions of this salt containing an equi-acidic quantity of this acid, whether free or combined, that the ratio $k[\frac{1}{2}C_6H_4(NH_2)_2,2HCl]/k[HCl] = 0{\cdot}5$ approximately. In other words, 50 per cent. of the salt is hydrolysed into the free base and acid. As the result is identical with that obtained by Bredig

(*Zeitsch. physikal. Chem.*, 1894, **13**, 214), it was thought that this very simple line of investigation might be pursued further. So far, the hydrochlorides of about 40 bases of various degree of complexity, ranging from hydroxylamine to cinchonidine, have been examined. Several results are found to be in accordance with the expression of Arrhenius, $k_b/k_w = (1 - x)v/x^2$ (*Zeitsch. physikal. Chem.*, 1881, **5**, **17**), even at the great dilutions examined, whilst in the case of bases of analogous composition the ratio of the hydrolysis values found is nearly equal to the ratio of the heats of neutralisation with hydrochloric acid.

*240. "The constituents of the essential oil of nutmeg." By Frederick Belding Power and Arthur Henry Salway.

The material employed in this investigation consisted of an oil which was distilled from unlimed Ceylon nutmegs of good quality, and was obtained in a yield of 6·94 per cent. It had d 15°/15° = 0·8690; α_D +38°4′ in a 1-dcm. tube; acid value, 0·81; ester value, 3·15. The more complete examination of the oxygenated constituents of the oil was accomplished by means of a product, designated heavy oil of nutmeg, from which the terpenes had been to a large extent removed. This had d 20°/20° = 1·102; α_D +1°17′ in a 1-dcm. tube; saponification value, 6·10.

This investigation has shown that the essential oil of nutmeg contains the following substances: (1) eugenol and (2) *iso*eugenol (about 0·2 per cent.); (3) *d*-pinene and (4) *d*-camphene (about 80 per cent.); (5) dipentene (about 8 per cent.); (6) *d*-linalool, (7) *d*-borneol, (8) *i*-terpineol, and (9) geraniol (about 6 per cent.); (10) a new *alcohol*, yielding on oxidation a *diketone*, $C_8H_{14}O_2$ (a very small amount); (11) a trace of an *aldehyde* resembling citral, but yielding a *β-naphthacinchoninic acid* derivative melting at 248°; (12) safrole (about 0·6 per cent.); (13) myristicin, $C_{11}H_{12}O_3$ (about 4 per cent.); (14) myristic acid, in a free state (about 0·3 per cent.), and apparently a small amount in the form of esters; (15) formic, acetic, butyric, and octoic acids, and a new *monocarboxylic acid*, $C_{13}H_{18}O_3$, all in the form of esters, and in relatively small amount.

This investigation has also shown that the portion of nutmeg oil which has hitherto been designated "myristicol" is a mixture of alcohols, of which terpineol appears to be the predominating constituent.

DISCUSSION.

Dr. WADE remarked that none of the constituents which had been isolated seemed to possess the characteristic odour of nutmeg, and asked whether the authors had been able to trace this odour to its source.

Dr. Power stated that the characteristic odour of nutmeg oil is not that of any individual substance, but is due to the mixture of odorous compounds contained in the oil.

*241. "The resolution of *sec.*-octyl alcohol (methylhexylcarbinol. Octane-2-ol)." By Robert Howson Pickard and Joseph Kenyon.

sec.-Octyl alcohol is readily converted into the acid phthalic ester. The dextro-*sec.-octyl hydrogen phthalate* is then obtained by the fractional crystallisation of its *brucine* salt from acetone, and the corresponding *lævo*-compound by the fractional crystallisation of the *cinchonidine* salt from aqueous acetone.

The *sec.*-octyl hydrogen phthalates have $[\alpha]_D$ 48·2° in ethyl-alcoholic solution, and when hydrolysed yield the pure alcohols which have $[\alpha]_D^{17}$ 9·87°.

242. "The velocity of reduction of the oxides of lead, cadmium, and bismuth by carbon monoxide, and the existence of the suboxides of these metals." By Francis Joseph Brislee.

The production of lead, cadmium, and bismuth suboxides by the reduction of the higher oxides with carbon monoxide has been investigated. The velocity of reduction of the oxides was determined by heating the oxides, contained in a porcelain boat, to 300° in an apparatus in which carbon monoxide was circulated. The boat was withdrawn from time to time and the loss in weight observed. The time interval varied from one and a half to six hours. The results were then plotted as time-reduction curves, and these showed a distinct break at the point at which the analytical composition of the product was near that required for the suboxide. The position of the break was not always at the suboxide point, the position depending on the relative velocities of the two reductions, namely:

(1) Oxide ⟶ suboxide.
(2) Suboxide ⟶ metal.

When the velocity of (1) is very different from (2), then the break will occur at the point when the oxide is entirely reduced to suboxide. When these two velocities are not very different, the first stage of the reduction is

(1*a*) Oxide ⟶ suboxide ⟶ metal,

and the second is:

(2*a*) Suboxide ⟶ metal,

and then the break will occur below the point, corresponding to complete reduction of the oxide to suboxide. The experiments made on the velocity of reduction of the oxides of lead, cadmium, and bismuth confirm Tanatar's results (*Zeitsch. anorg. Chem.*, 1901, **27**, 304) that the suboxides of these metals are definite chemical compounds, but do not prove the stability of these compounds. The suboxides of lead, cadmium, and bismuth are formed as intermediate phases in the reduction of the oxide to metal by carbon monoxide.

243. "The relation between unsaturation and optical activity. Part I. The menthyl and bornyl esters of β-phenylpropionic, cinnamic, and phenylpropiolic acids." By Thomas Percy Hilditch.

In order to throw further light on Walden's statement that increase of unsaturation in a compound is accompanied by increase in rotatory power, the author has prepared and investigated the properties of the menthyl and bornyl esters of the above three acids. Menthyl hydrocinnamate (m. p. 28°), menthyl phenylpropiolate (m. p. 33°), and bornyl phenylpropiolate (m. p. 45°) were obtained as nearly colourless, crystalline solids, whilst the other three esters were found to be liquid at the ordinary temperature. The boiling points of the compounds, as well as the specific gravities, seem to show a regular increase with increase of unsaturation, whilst the refractive indices rise with a change to an ethylenic linking, but fall to an intermediate value for the further change to an acetylenic compound.

The following conclusions were arrived at as regards optical activity:

(1) The change in rotation for either change of constitution is relatively small.

(2) The changes are nevertheless perfectly definite, and occur in a regular manner for corresponding stages of unsaturation (the rotations being measured at three successive concentrations in each of two solvents, chloroform and acetone).

(3) The conversion of a saturated to an ethylenic bond is accompanied by an increase in optical activity, whilst the change from a saturated to an acetylenic linking produces a decrease in rotatory power.

(4) In the case of esters, the change in rotation must be measured with reference to the difference between the specific rotation of the ester and that of the active alcohol from which it was formed.

(5) Walden's results are confirmed so far as the change to an ethylenic linking is concerned, but there is a discrepancy with regard to the influence of the triple bond on the optical activity.

244. "Methyl ethers of some hydroxyanthraquinones." By Arthur George Perkin.

The author has re-examined the principal non-tinctorial derivatives of anthraquinone present in Chay-root, *Oldenlandia umbellata* (Perkin and Hummel, *Trans.*, 1893, **63**, 1160, and 1895, **67**, 817), and finds, contrary to the suggestion of Böck (*Monatsh.*, 1902, **23**, 1008), that these compounds possess the constitution previously assigned to them, and do not contain reduced anthraquinone nuclei. The anthragallol dimethyl ether (*A*), m. p. 209, when treated with alcoholic potassium acetate, gives the salt, $C_{16}H_{11}O_5K$, in violet-coloured leaflets, and on methylation forms *anthragallol trimethyl ether*, which crystallises in pale yellow needles, m. p. 167—168°. Anthragallol dimethyl ether (*B*) on methylation gives the same trimethyl ether, but the melting points of this dimethyl ether and its acetyl derivative, previously given as 225—227° and 175° respectively, are now found to be 230—232° and 176—178°. Experiments indicate that, whereas in the compound (*A*) the methoxy-groups are present in the positions 1 : 3, in (*B*) they occupy the positions 1 : 2. Alizarin α-methyl ether, m. p. 177—179°, on methylation gives alizarin dimethyl ether, m. p. 210—211°, and its acetyl compound, m. p. 212°, contains only one acetyl group. With potassium acetate, it gives a potassium salt, which forms garnet-red, prismatic needles.

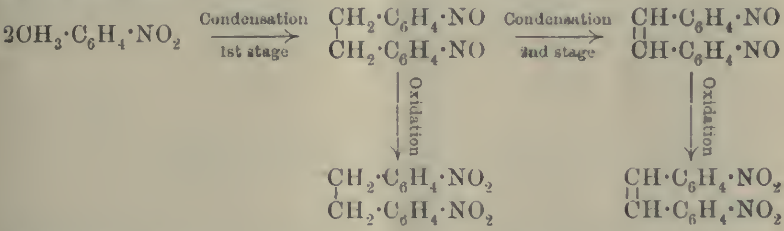
Hystazarin monomethyl ether on methylation gives *hystazarin dimethyl ether*, yellow needles, m. p. 235—236°, identical with the compound prepared from hystazarin itself. Finally, the natural *m*-hydroxyanthraquinone gave the methyl ether, m. p. 192—193°. The so-called anthragallol dimethyl ether (*C*) was previously isolated in so small an amount that it could not be profitably re-examined, but, as the description of Böck's dimethyl ether (*loc. cit.*) does not agree with that assigned to this compound, it is possibly not a distinct substance.

A re-examination of emodin monomethyl ether (Perkin and Hummel, *Trans.*, 1894, **65**, 923) has confirmed the properties, melting point, &c., previously assigned to it, so that Oesterle's conjecture that it is identical with his trihydroxymethylanthraquinone monomethyl ether (*Arch. Pharm.*, 1907, **245**, 287) is incorrect.

245. "The colouring matters of the stilbene group. Part IV. Action of caustic alkalis on para-nitrotoluene and its derivatives." By **Arthur George Green, Arthur Hugh Davies, and Ronald Smith Horsfall.**

The authors find that the product of oxidation of substituted *p*-nitrotoluenes under the influence of caustic alkalis is largely dependant on the reactivity of the particular compound employed, this being determined by the nature of the ortho-substituent. Thus, whilst the cyano-derivative (like the chloro-derivative and the phenyl sulphonate already investigated) gave only a stilbene derivative, dibenzyl compounds were obtained from the methyl, methoxy-, and carboxy-derivatives, and both stilbene and dibenzyl derivatives from *p*-nitrotoluene itself. Those derivatives which react least easily with production of red condensation products yield dibenzyl compounds by preference, whilst those which react most readily and form violet to blue condensation products give chiefly stilbene compounds.

The results point to the conclusion that the condensation in question occurs in two stages, which may be more or less concurrent according to the degree of reactivity of the substance. The product of the first stage, when oxidised, gives a dinitrodibenzyl, that of the second stage a dinitrostilbene:



$$\begin{tikzcd} 2CH_3\cdot C_6H_4\cdot NO_2 \arrow[r, "\text{Condensation}", "\text{1st stage}"'] & \begin{array}{l} CH_2\cdot C_6H_4\cdot NO \\ | \\ CH_2\cdot C_6H_4\cdot NO \end{array} \arrow[r, "\text{Condensation}", "\text{2nd stage}"'] \arrow[d, "\text{Oxidation}"] & \begin{array}{l} CH\cdot C_6H_4\cdot NO \\ \| \\ CH\cdot C_6H_4\cdot NO \end{array} \arrow[d, "\text{Oxidation}"] \\ & \begin{array}{l} CH_2\cdot C_6H_4\cdot NO_2 \\ | \\ CH_2\cdot C_6H_4\cdot NO_2 \end{array} & \begin{array}{l} CH\cdot C_6H_4\cdot NO_2 \\ \| \\ CH\cdot C_6H_4\cdot NO_2 \end{array} \end{tikzcd}$$

Substituents which increase the reactivity of the substance therefore favour the formation of stilbene compounds.

A comparison of the relative reactivity of a number of such compounds under like conditions shows that, whilst the methyl, methoxy-, amino-, and carboxy-groups have but little influence on the reactivity, the more strongly electronegative groups, such as the sulphophenyl, cyano- and nitro-groups, exert a powerful effect, that of the nitro-group being the strongest.

246. “The replacement of alkyl radicles by methyl in substituted ammonium compounds.” By Humphrey Owen Jones and John Robertshaw Hill.

It has been shown previously (*Proc.*, 1901, **17**, 205; *Trans.*, 1905, **87**, 1726) that the allyl and benzyl groups are readily displaced from amines or quaternary ammonium compounds by the methyl group on treatment with methyl iodide either at the ordinary temperature or at 100°.

The authors now find that the other alkyl groups, ethyl, propyl, *iso*propyl, butyl, *iso*butyl, and *iso*amyl, are all replaced by methyl, sometimes in the cold, but more easily on heating with methyl iodide.

The two series of ammonium compounds derived from dimethylaniline and *p*-bromodimethylaniline (Hill, *Proc. Camb. Phil. Soc.*, 1907, **14**, 166) have been examined, and the phenyltrimethyl compound is the final product in each case. The replacement is due to the dissociation of the ammonium salt, in methyl iodide solution, into tertiary amine and alkyl iodide, the tertiary amine then combines with methyl iodide to produce the trimethyl compound, which is, in each case, much the least soluble of all. The ease with which the different groups are replaced varies considerably, and is dependent jointly on the extent to which the dissociation takes place and on the solubility of the ammonium salt. The ethyl or *iso*butyl group is most readily replaced, and the *iso*amyl group is the most difficult to displace.

247. “Note on the formation of abnormal platinichlorides. (A correction.)” By Albert Ernest Dunstan.

In a recent communication (Dunstan and Cleaverley, *Trans.*, 1907, **91**, 1619), the preparation of three platinichlorides of the general formula B_4,H_2PtCl_6 was described. These were thought to belong to a new type of platinichlorides, but this is now found to be a mistake, as Werner (*Ber.*, 1903, **36**, 147) had collected all instances of such abnormalities known up to that date. Subsequently, Morgan and Micklethwait (*Trans.*, 1906, **89**, 863) added the cases of coumarin platinichloride and aurichloride, whilst Pickard and Kenyon have described (*Trans.*, 1906, **89**, 268) triethyl-, tripropyl-, and tribenzylphosphine oxide hydrogen platinichlorides, the latter of which had been prepared by Fleissner (*Ber.*, 1880, **13**, 1665) and by Letts and Collie (*Trans. Roy. Soc. Edin.*, 1888, **30**, I, 181).

248. "The nitrates of dimethyl- and methylethyl-thetine menthyl esters." By Samuel Smiles.

The nitrates of dimethyl- and methylethyl-thetine menthyl esters were prepared by precipitating concentrated aqueous solutions of the bromides with aqueous ammonium nitrate. *Dimethylthetine* l-*menthyl ester nitrate* forms colourless prisms which melt at 125—127° and are very sparingly soluble in cold water or ethyl acetate, but readily so in the hot media. In alcoholic solution, (1) 2 per cent. the salt has $[\alpha]_D$ $-53{\cdot}9°$ and $[M]_D$ $-173°$ approximately. *Methylethyl*-d-l-*thetine* l-*menthyl ester nitrate* has $[M]_D$ about $-178°$ in the same solvent; it melts at 120—122°, and is slightly more soluble than the dimethyl derivative. The methylethyl salt was fractionally crystallised from ethyl acetate with a view to resolving the thetine into optical isomerides. The experiments have been hitherto unsuccessful, probably owing to the instability of the ester to which attention has already been drawn (*Trans.*, 1905, **87**, 451). The less soluble fraction contained the dimethylthetine ester, indicating the decomposition of the salt. The rotatory powers of the platinichlorides of the dimethyl and methylethyl derivatives are corrected from these already given to $[M]_D$ $-438°$ for the dimethyl and $[M]_D$ $-380°$ approximately for the methylethylthetine, that for the diethyl being, as before, $[M]_D$ $-330°$.

249. Synthesis of brazilinic acid and the lactones of dihydrobrazilinic and dihydrohæmatoxylinic acids. (Preliminary note.) By William Henry Perkin, jun., and Robert Robinson.

Brazilinic acid is formed when trimethylbrazilin is oxidised by permanganate (*Trans.*, 1902, **81**, 1030):

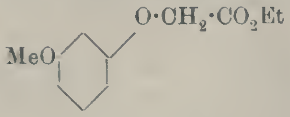
$$C_{19}H_{20}O_5 + O_5 = C_{19}H_{18}O_9 + H_2O,$$

and, on reduction, is converted into the lactone of dihydrobrazilinic acid:

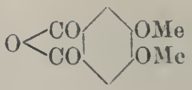
$$C_{19}H_{18}O_9 + 2H = C_{19}H_{18}O_8 + H_2O.$$

Since these two acids contain the same number of carbon atoms as trimethylbrazilin, it seemed probable that the determination of their constitutions might yield information which would definitely prove the constitution of brazilin. The authors have succeeded in synthesising brazilinic acid, the lactone of dihydrobrazilinic acid, and also the corresponding lactone of dihydrohæmatoxylinic acid by methods which leave no doubt as to their constitutions.

Brazilinic acid (m. p. 208°) is obtained in small quantity when a mixture of *m*-methoxyphenoxyacetic ester and *m*-hemipinic anhydride



and



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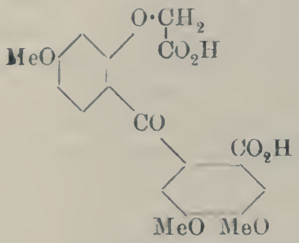
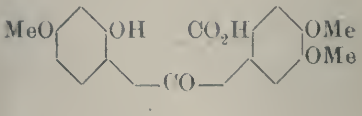
is dissolved in carbon disulphide and treated with aluminium chloride. This synthesis clearly indicated that brazilinic acid must be represented by the formula (I),



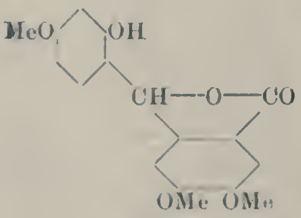
(I.)



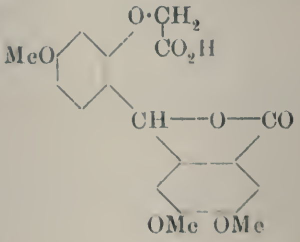
(II.)

and further proof of this was obtained by the synthesis of the *lactone* of *dihydrobrazilinic acid*, which was accomplished in the following way. A mixture of resorcinol dimethylether and *m*-hemipinic anhydride, when treated with aluminium chloride, yields *hydroxytrimethoxybenzoylbenzoic acid* (II).

Reduction with sodium amalgam converts this acid into *hydroxymethoxyphenyl*-m-*meconine* (m. p. 207°) (III):



(III.)

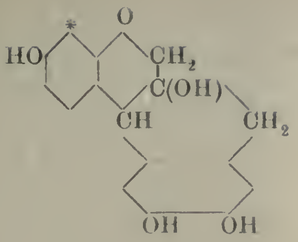


(IV.)

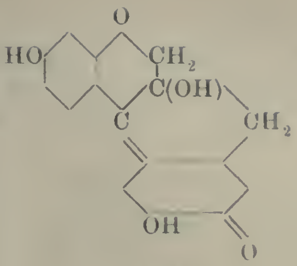
When this substance is treated with chloroacetic acid and potassium hydroxide, it is converted into an acid which melts at 226—227° and is identical with the *lactone* of *dihydrobrazilinic acid*.

The latter acid must therefore have the constitution (IV).

This synthesis not only confirms the constitution given above to brazilinic acid, but the authors consider that it proves clearly that brazilin must be represented by the constitutional formula (V),



(V.)

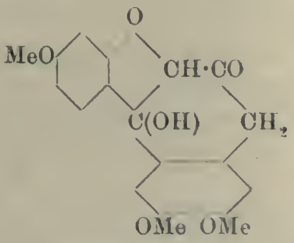


(VI.)

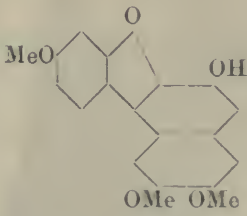
first suggested by Werner and Pfeiffer (*Chem. Zeitsch.*, 1904, **3**, 421).

The *lactone* of *dihydrohæmatoxylinic acid* (m. p. 192°) was similarly synthesised from pyrogallol trimethyl ether and *m*-hemipinic anhydride by treatment with aluminium chloride and subsequent reduction and treatment with potassium hydroxide and chloroacetic acid. The constitution for hæmatoxylin is therefore derived from the above formula for brazilin by the introduction of a hydroxy-group at the point indicated by the asterisk.

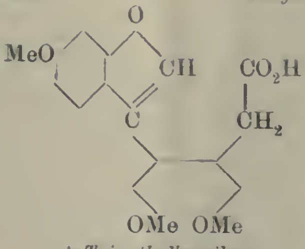
An entirely different series of experiments on brazilein, carried out in conjunction with Paul Engels, has shown that the constitution of this important substance is represented by (VI), an expression easily derived from the formula of brazilin given above. In the detailed account of the authors' experiments, it will be further shown that the important derivatives of trimethylbrazilin, namely, trimethylbrazilone, α-anhydrotrimethylbrazilone and ψ-trimethylbrazilone, have constitutions represented by the formulæ:



Trimethylbrazilone.



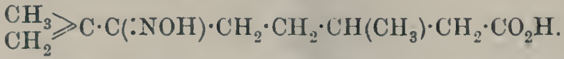
α-Anhydrotrimethylbrazilone.



ψ-Trimethylbrazilone.

250. "Condensations of ketones containing the group $\cdot CH_2\cdot CO\cdot CH\colon$ with esters in presence of sodium ethoxide." By Reginald William Lane Clarke, Arthur Lapworth, and Elkan Wechsler.

It has already been shown (*Trans.*, 1907, **91**, 1919) that when cyanodihydrocarvone, which contains the above grouping, is acted on by nitrous esters in presence of sodium ethoxide, the attack occurs at the $\cdot CH\colon$ group. It is now proved that menthone reacts in the same way, although when alkyl formates are used under analogous conditions it is the $\cdot CH_2\cdot$ group which is reactive. Pulegone appears first to be converted into *iso*pulegone, which then behaves like menthone, yielding a *hydroximino-acid* having the structure:



$$\genfrac{}{}{0pt}{}{CH_3}{CH_2}\!\!\geqslant C\cdot C(\colon NOH)\cdot CH_2\cdot CH_2\cdot CH(CH_3)\cdot CH_2\cdot CO_2H.$$

Bromocamphor yields only *iso*nitrosocamphor, and fenchone, in accordance with Semmler's view of its constitution, is quite unaffected.

The fact, that esters of different kinds, acting under the influence of sodium ethoxide and similar agents, appear to select different points for attack on ketones containing the group $\cdot CH_2\cdot CO\cdot CH\colon$, is shown to be of considerable importance in connexion with the question of the mechanism of syntheses brought about by such agents.

251. "Acylogens and thiocarbamides." By Augustus Edward Dixon and John Taylor.

Following up their previous inquiries in the above direction (*Trans.*, 1907, **91**, 912. Compare also Dixon and Hawthorne, *ibid.*, 122), the authors have now studied the behaviour of certain acyl chlorides with allyl-substituted thiocarbamides, and of phenylthiocarbamide with halogenised acyl halides.

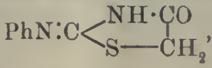
Acetyl chloride unites with allylthiocarbamide to form

$$C_3H_5\cdot NH\cdot C(NH)\cdot SAc,HCl,$$

white crystals, melting at 103—104°. On withdrawal of the combined halogen acid by weak alkali, the acetyl group migrates with production of $C_3H_5\cdot NAc\cdot CS\cdot NH_2$, m. p. 96°, the latter, when melted, undergoing further change into $C_3H_5\cdot NH\cdot CS\cdot NHAc$, m. p. 74°; of these three isomeric forms, the first alone is basic.

With *ab*-phenylallylthiocarbamide, acetyl chloride yields *N*-phenylpropylene-ψ-thiourea (Prager, *Ber.*, 1889, **22**, 2992).

Methyl chlorocarbonate gives with *ab*-phenylallylthiocarbamide the compound $C_3H_5\cdot NH\cdot C(NPh)\cdot S\cdot CO_2Me,HCl$, m. p. 87°; from this, water eliminates the halogen acid, and the carboxymethyl group thereupon migrates to form $C_3H_5\cdot N(CO_2Me)\cdot CS\cdot NHPh$, m. p. 83°. Ethyl chlorocarbonate behaves similarly, the hydrochloride melting at 96°, and yielding by treatment with water the corresponding trisubstituted thiocarbamide as a non-basic oil.

Chloroacetyl chloride and bromopropionyl bromide react readily with phenylthiocarbamide, but not to produce additive compounds; instead, two molecules of halogen acid are eliminated, one of which passes off, the other remaining combined with the product, a ring compound, either "phenylthiohydantoin,"  $PhN{:}C{<}\begin{array}{l}NH\cdot CO\\ S\text{—}CH_2\end{array}$, or its methylic homologue, as the case may be.

Acetyl chloride combines with benzyl-ψ-thiourea,

$$NH_2\cdot C(NH)\cdot S\cdot CH_2Ph,$$

furnishing the hydrochloride of an acetyl derivative, and, conversely, benzyl chloride unites additively with acetylthiocarbamide; whether the products are identical or isomeric could not be decided, owing to the readiness with which they decompose yielding benzyl mercaptan.

252. "The alkyl compounds of gold." By William Jackson Pope and Charles Stanley Gibson.

The authors have prepared *monoethylauric dibromide*, $(C_2H_5)AuBr_2$, and *amminodiethylauric bromide*, $(C_2H_5)_2AuBr,NH_3$ (compare also *Proc.*, 1907, **23**, 245).

253. "The refractive power of diphenylhexatriene and allied hydrocarbons." By Ida Smedley.

The molecular refractions of diphenylbutadiene and diphenylhexatriene (*Proc.*, 1907, **23**, 162) were measured and compared with those of other hydrocarbons. Sufficient data have been obtained to calculate the influence of the phenyl and the ethenoid groups in unsaturated hydrocarbons. In each case, the refractive power of the group increases markedly as the number of unsaturated groups with which it is conjugated increases. The influence of the hexatriene structure is always greater than that of the benzene ring, a result considered by the author to be at variance with the representation of the benzene molecule as a closely conjugated system of double bonds.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Cohen, *Julius B.* Organic chemistry for advanced students. pp. viii + 632. London 1907. (*Recd.* 28/11/07.) From the Author.

Goppelsroeder, *Friedrich.* Neue Capillar- und Capillaranalytische Untersuchungen. pp. xiv + 81. ill. Basel 1907. (*Recd.* 22/11/07.) From the Author.

Hutton, *Frederick Wollaston.* The lesson of evolution. 2nd edition. pp. xxiv + 301. Printed for private circulation, [Erith] 1907. (*Recd.* 7/11/07.) From Mrs. F. W. Hutton.

Kingzett, *Charles Thomas.* Nature's hygiene and sanitary chemistry: containing also a special account of the chemical and hygienic characters of eucalyptus, pine and camphor forests, and some industries connected therewith. 5th edition. pp. xvi + 527. London 1907. (*Recd.* 27/11/07.) From the Author.

II. *By Purchase.*

Mayow, *John.* Medico-physical works. Being a translation of *Tractatus quinque medico-physici*, 1674. (Alembic Club Reprints, No. 17.) pp. xxiii + 331. ill. Edinburgh 1907. (*Recd.* 22/11/07.)

Méyer, *Victor*, and **Jacobson,** *Paul.* Lehrbuch der organischen Chemie. 2 Auflage, Band I. i, 2. pp. 449—1060. Leipzig 1907. (*Recd.* 14/11/07.)

Wiley, *Harvey W.* Foods and their adulteration. Origin, manufacture, and composition of food products; description of common adulterations, food standards, and national food laws and regulations. pp. xii + 625. ill. London [printed in America] 1907. (*Recd.* 22/11/07.)

III. *Pamphlets.*

Borns, *Henry.* Die Elektrochemie in Jahre 1906. (From the *Chem. Industrie*, **30**, 1907.)

Burgess, *G. K.* Melting points of the iron group elements by a new radiation method. (From the *Bull. Bureau of Standards*, **3**, 1907.)

Neogi, *Panchanan.* Notes from the Chemical Laboratory of the Presidency College. Note No. 1. A new method of preparing mercurous iodide. (From the *J. and Proc. Asiatic Soc. of Bengal*, **3**, 1907.)

Sandberg, *Christer Peter.* The chemical composition of steel rails and latest improvements. (From the *Trans. Engineering Conference, Inst.C.E.*, 1907.)

Schaefer, *Theodore W.* The contamination of the air of our cities with sulphur dioxide, the cause of respiratory disease. (From the *Boston Med. and Surg. Jour.*, **157**, 1907.)

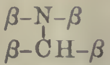
Svedberg, *The.* Studien zur Lehre von den kolloiden Lösungen. (From the *Nova Acta Reg. Soc. Sci. Ups.*, [iv], **2**, 1907.)

Watts, *Oliver Patterson.* An investigation of the borides and the silicides. (From the *Bull. Univ. Wisconsin. Engineering Ser.*, **3**, 1906.)

At the next Ordinary Meeting, on **Thursday**, December **19th**, 1907, at **8.30** p.m., the following papers will be communicated:

"Derivatives of tetramethyl glucose." By J. C. Irvine and A. M. Moodie.

"The characterisation of mercerised cotton." (Preliminary note.) By J. Hübner.

"Attempted synthesis of  $\begin{array}{c}\beta\text{–N–}\beta\\ |\\ \beta\text{–CH–}\beta\end{array}$ dinaphthacridine: Condensation of methylene dichloride and *l*-substituted-2-naphthylamines." By A. Senier and P. C. Austin.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/12/07

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 23. No. 334.

Thursday, December 19th, 1907, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

The President referred to the death of Lord Kelvin, and stated that the Society would be represented at his fune ra

It was also announced that the Society had lost through death Mr. Samuel Hall, and Prof. B. J. Harrington, of McGill University, Montreal.

Messrs. P. V. Dupré, G. H. Martin, C. P. Matthews, W. S. Mills, M. Wechsler, E. Wheeler, and R. Whymper were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Guy Barr, B.A., B.Sc., 79, Fillebrook Road, Leytonstone, N.E.
Walter Brown, jun., Brookvale, Strathaven, N.B.
David Cowan Crichton, M.A., B.Sc., A.I.C., Backhill House, Musselburgh.
Andrew L. Scott, F.I.C., Fir Lodge, Cheshunt, Herts.
John Armstrong Smythe, 15, The Poplars, Gosforth, Newcastle-on-Tyne.
Charles Sedgley Spiers, The Woodlands, Scalford Road, Melton Mowbray.

John Watson, B.Sc., 5, Kendrew Street, Darlington.
William Henry Withey, B.A., Stroud, Glos.
Joseph Yates, 18, Park Street, Haslingden, Lancs.

Certificates have been authorised by the Council under Bye Law I (3) in favour of the following :

Puran Singh, Dehra Dun, India.
Archibald Edgar Collens, Government Laboratory, Port of Spain, Trinidad.

Of the following papers, those marked * were read :—

*254. "Attempted synthesis of $\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \beta\text{–CH}\beta\end{array}$-dinaphthacridine; condensation of methylene dichloride and 1-substituted-2-naphthylamines." By Alfred Senier and Percy Corlett Austin.

In attempting to synthesise derivatives of the unknown $\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \beta\text{–CH}\beta\end{array}$-dinaphthacridine (compare Senier and Austin, *Trans.*, 1906, **89**, 1387) by condensing methylene dichloride with derivatives of β-naphthylamine in which the hydrogen of the α-position adjacent to the amino-group had been substituted, the authors have found that when the substituent was a halogen, either Reed's dinaphthacridine or a meso-derivative thereof was formed, thus completing the proof that this base has the constitution assigned to it. In the case of 1-nitro-2-naphthylamine, no acridine was obtained.

1-Chloro-2-naphthylamine reacts with methylene dichloride to form $\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \alpha\text{–CH}\alpha\end{array}$-dinaphthacridine. 1-Bromo-2-naphthylamine and methylene dichloride yield *7-bromo-*$\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \alpha\text{–CH}\alpha\end{array}$*-dinaphthacridine*, which crystallises from benzene in yellow needles, melting at 215·5° (corr.). Its solutions are fluorescent, and it differs from the halides of the dinaphthacridines (Senier and Austin, *Trans.*, 1904, **85**, 1196), as it may be boiled with potassium hydroxide solution, and even distilled under reduced pressure, without decomposition.

The *hydrochloride*, *aurichloride*, and *platinichloride* are yellow powders.

With glacial acetic acid, the base forms a deep yellow, crystalline *compound*, melting at 273°. Reduction with stannous chloride leads to the production of bis-$\begin{array}{c}\beta\text{–N–}\beta\\ \vert\\ \alpha\text{–CH}\alpha\end{array}$-dinaphthacridine dihydride.

*255. "Cobaltamine compounds." (Preliminary note.)
By Charles Edward Groves.

During the past few years, the author has investigated some of the cobaltamine compounds, and owing to the recent appearance of papers on the subject, he considers it advisable to publish a preliminary account of some of the results obtained.

Crimson Carbonate.—When freshly-precipitated cobalt carbonate, suspended in dilute ammonia, is agitated with air and then exposed to the air for three or four days, the solution becomes brownish-red and deposits bright crimson crystals. These can be purified by recrystallisation from water at about 45°, or, better, from a very dilute solution of ammonium bicarbonate. The carbonate is readily decomposed by acids with evolution of carbon dioxide, and formation of the corresponding salts. It is almost insoluble in cold water, but on heating gently (45°) the crystals dissolve; at a higher temperature, the solution becomes brown and turbid. The substance is practically insoluble in dilute ammonia in the cold, and very little dissolves even on heating It is almost insoluble in dilute alcohol even on boiling. The author purposes, provisionally, calling this compound *carycino-cobaltamine carbonate* (*καρύκινος*, blood-red).

Blue-black Compound.—This is formed when the crimson carbonate is treated with nitro-hydrochloric acid. On gradually adding the latter to the carbonate under water, it dissolves with effervescence, but on adding more of the acid a red, crystalline precipitate is produced, which if left in the liquid for a day or more is converted into the "bluish-black" crystals. This compound dissolves readily in concentrated ammonia, forming a rose-coloured liquid. When boiled with hydrochloric acid, it is, apparently, completely converted into the purpureo-chloride. In an aqueous solution of ammonium bicarbonate, it dissolves to a purple liquid.

Bronze-green Chloride and the corresponding *Nitrate.*—Of these two salts, the nitrate is the more readily prepared, and it can be easily converted into the chloride, which is bronze-green, the colour of the nitrate being greyish-green. The nitrate is most easily prepared by gradually adding a solution of cobalt nitrate in dilute nitric acid, in the proper proportion, to a mixture of dilute ammonia with a solution of ammonium persulphate contained in a large flask, and, after it is thoroughly oxidised by shaking it with air, acidifying the mixture with dilute nitric acid.

This nitrate is almost insoluble in water, but dilute ammonia dissolves it readily, forming a pink solution, and it is also soluble in ammonium bicarbonate solution. It is neither altered nor dissolved by nitric acid, whether concentrated or dilute, and it is also insoluble in boiling acetic acid, but on adding concentrated hydrochloric acid to the mixture it dissolves at once.

The hydrochloride is easily obtained from the nitrate by heating the latter with dilute hydrochloric acid (1 : 2) at 70° for twenty to twenty-five minutes. It can easily be recrystallised from hot very dilute hydrochloric acid, when it separates in long, bronze-green needles. The purified hydrochloride dissolves in cold water, forming a deep blue liquid, but this soon decomposes, especially when warmed, depositing a brown powder, apparently cobaltous-cobaltic oxide.

Grass-green Compound.—If purpureo-cobaltic chloride (or nitrate) is heated for some hours with dilute ammonia, or, better, ammonium carbonate solution, it dissolves, and the dark red solution containing roseo-cobaltic salt, if kept for some time, deposits a crystalline mass consisting of minute, pink needles. After these have been separated, concentrated nitric acid is added to the mother liquor, the brick-red precipitate thus formed is removed by filtration, and a slow current of crude nitrosyl chloride passed into the purple-red filtrate. This after twenty-four hours deposits a mixture of red and green crystals. These can be separated by washing with water, which easily dissolves the red crystals, leaving the grass-green compound, which is comparatively insoluble in water.

This green salt is only sparingly soluble in water and in dilute ammonium bicarbonate solution, and is practically insoluble in alcohol and dilute acids. When boiled with dilute hydrochloric acid, it appears to be converted into the purpureo-chloride.

*256. "The direct interaction of aryl halides and magnesium."

By James Frederick Spencer and Eleanor Marguerite Stokes.

The authors find that cyclic halogen compounds react with magnesium powder without the use of ether when the two substances are heated together. The products, which are of the type $R \cdot MgX$, are light grey solids, and are readily decomposed by water with considerable evolution of heat and production of the hydrocarbon:

$$R \cdot MgI + H_2O = R \cdot H \cdot + Mg(OH)I.$$

Iodo- and bromo-benzene yielded benzene and diphenyl; *p*-iodo- and *o*-bromo-toluene gave toluene; *m*-bromo- and *o*-chloro-aniline gave aniline; *p*-bromo-phenol yielded phenol, and *a*-bromonaphthalene and bromoacenaphthene gave the respective hydrocarbons. The yields in all these cases were extremely good. Chloro-substitution products do not react generally in this way. In the case of aliphatic compounds, methyl iodide, methylene iodide, and *iso*propyl iodide were indifferent, but bromosuccinic acid gave succinic acid.

DISCUSSION.

Dr. McKENZIE pointed out the interest of the observations of the authors in connexion with Tschelinzeff's results with the "individual" magnesium compounds of the type R·MgX, obtained by the interaction of magnesium and halogen compounds in benzene solution with the use of dimethylaniline as catalyst.

In view of the results of Schroeter (*Ber.*, 1903, **36**, 3005) on the action of carbon dioxide on magnesium phenyl bromide, Dr. McKenzie asked if the formation either of triphenylcarbinol or benzophenone had been noted by the authors in the experiment on the formation of benzoic acid described by them.

Dr. SPENCER replied that, owing to the large yields obtained, triphenylcarbinol and benzophenone had not been looked for, and their formation could only take place to a small extent, if at all.

257. "Derivatives of tetramethyl glucose." By James Colquhoun Irvine and Agnes Marion Moodie.

Tetramethyl glucoseoxime, which was obtained as a mixture of α- and β-forms melting at 61—68°, shows in methyl-alcoholic solution a specific rotation of +25·9° without mutarotation. The constitution of the compound, deduced from its behaviour on alkylation and the hydrolysis of the product, shows that it does not possess the normal oxime structure, but is produced by the reaction of the sugar in its γ-oxidic forms. Similar arguments point to the fact that tetramethyl glucoseanilide also possesses the γ-oxidic linking, and is not derived from an alkyloxy-aldehyde. The compound melted at 132—134°, and gave $[\alpha]_D^{20} + 229 \cdot 5°$ in acetone solution.

Tetramethyl chloroglucose and *tetramethyl bromoglucose* were obtained as uncrystallisable syrups, which, in their reactions, closely resemble the corresponding tetra-acetyl compounds. As they were readily converted into a mixture of α- and β-tetramethyl methylglucosides when treated with methyl alcohol and silver oxide, the preparations doubtless consisted of mixtures of α- and β-forms.

Negative results were obtained in attempts to produce acetal derivatives of tetramethyl glucose, and the application of the Grignard reaction also led to no result.

With one doubtful exception, all the derivatives studied indicate that the alkylated sugar reacts invariably in the γ-oxidic form, but this characteristic linking appears to be absent in tetramethyl glucosehydrazone.

In the course of the work, it was found that the silver oxide method of alkylation can be readily applied to the methylation of different types of oximes, thus furnishing a convenient method of determining the hydroxyl content of such compounds.

258. "The characterisation of mercerised cotton." (Preliminary note.) By Julius Hübner.

The author has studied the action of a number of reagents on cotton, both before and after mercerisation, and finds that the following methods afford a certain means of distinguishing between mercerised and non-mercerised cotton, and also enable the degree of mercerisation to be approximately ascertained.

The cotton to be examined is steeped in a saturated solution of potassium iodide containing iodine; after a few seconds' immersion, the sample is withdrawn and washed five or six times in a 2 per cent. potassium iodide solution. After this treatment, mercerised cotton is found to have acquired a brownish-black colour, whilst unmercerised cotton remains white; on then treating the samples with water, the mercerised cotton turns bluish-black and the unmercerised sample remains quite white.

Another convenient method for distinguishing between mercerised and untreated cotton consists in steeping the samples in an aqueous solution, 100 c.c. of which contain 93·3 grams of zinc chloride and about 0·005 gram of iodine; in this liquid, non-mercerised cotton remains practically white, whilst the mercerised material becomes of a dark navy-blue colour.

259. "Note on the action of metallic calcium on alcohols." By Frederick Mollwo Perkin and Lionel Pratt.

It has been stated that metallic calcium has no action on alcohol, and may therefore be employed as a dehydrating agent for alcohols. The authors find, however, that, when metallic calcium is allowed to remain in contact with ethyl or methyl alcohol for from thirty to sixty minutes, reaction ensues and may become very vigorous. Once started the reaction continues to completion, according to the equation: $2CH_3{\cdot}OH + Ca = (CH_3{\cdot}O)_2Ca + H_2$.

If the mixture is heated to the boiling point of the alcohol, the reaction proceeds much more rapidly. With propyl, *iso*butyl, amyl, and benzyl alcohols, the reaction takes place exceedingly slowly at the ordinary temperature, but completes itself in the course of a few hours at the boiling point of the alcohol. Analysis shows the white, amorphous powder obtained in all cases to be $(Alk\cdot O)_2Ca$.

260. "Note on the iodates and periodates of the alkalis and the ammonium radicle." By Thomas Vipond Barker.

The author gave a description of rubidium periodate, together with an account of some specific gravity and solubility determinations of the iodates of rubidium and cæsium, and the periodates of sodium, potassium, rubidium, cæsium, and ammonium.

261. "The colour of cupric salts in aqueous solution." By Nevil Vincent Sidgwick and Henry Thomas Tizard.

The authors have measured the depth of colour of aqueous solutions of cupric salts from the point where they become blue, and the influence on it of the anion and the concentration, using the Donnan tintometer. The main results are:

(1) All the salts examined (propionate, acetate, formate, monochloroacetate, chloride, bromide, sulphate, nitrate) showed the same tint at dilutions greater than about $N/4$, but the depth of colour varied with the anion and the dilution. This shows that they contain at least two substances of the same tint, but of different depths of colour.

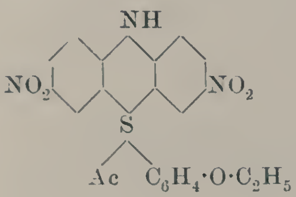
(2) The weak acid salts are deeply coloured at high concentrations, and the more so the weaker the acid. On dilution, the colour diminishes, tending to a value from two to four times that for copper sulphate, according to the acid, and hence greater than that of the cupric ion. It is therefore suggested that the change is due to the dissociation of CuA_2 into $CuA^{\cdot}$, which must then proceed very far before the second dissociation giving $Cu^{\cdot\cdot}$ ions begins. The second dissociation constant of a ternary salt, MX_2, should be very small, in accordance with Ostwald's theory for dibasic organic acids, as the positive charge on the metal in the ion $MX^{\cdot}$ will resist the appearance of a second charge on M.

(3) The salts of strong acids are always much paler than those of weak. On dilution the colour deepens, but only slightly. With copper nitrate, the complexes formed in very concentrated solution are of the same blue colour as the copper ion, but deeper.

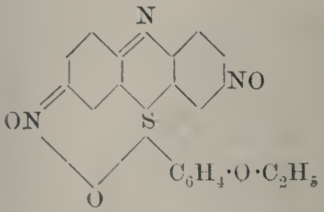
(4) It thus seems probable that ionisation affects the intensity of the colour, but not the tint.

262. "Derivatives of *S*-phenylphenazothionium." Part I. By Samuel Smiles and Thomas Percy Hilditch.

The α- and β-dinitro-compounds obtained from thiodiphenylamine by the action of nitric acid (Bernthsen, *Annalen*, 1885, **230**, 116) yield the sulphates of bases when condensed with phenetole in presence of concentrated sulphuric acid. Thus Bernthsen's view that these substances are sulphoxides is confirmed. The condensation products referred to are salts of *S*-phenetyl-3 : 3′-dinitrophenazothionium (I);



I.



II.

these are converted by aqueous alkali into the reddish-brown, fluorescent thetine (II). Hydrolysis of the salts furnishes the crimson sulphonium hydroxide. Derivatives of *S*-phenetyl-*N*-methylphenazothionium have been prepared in the same way; here, as with the above-mentioned compounds, the salts are green, but the base is dull brown and not fluorescent. A synthesis of these substances was attempted by the condensation of di-*p*-nitrodiphenylamine and phenetole-*p*-sulphinic acid, but the reaction could not be carried beyond the intermediate stage of the sulphoxide.

263. "A colorimetric method for the determination of small percentages of iron in copper alloys." By Arnold William Gregory.

The method is based upon the colour reaction given by salicylic acid and ferric chloride. This reaction is modified by using a solution of salicylic acid in acetic acid, and the test is carried out in the presence of sodium acetate. Under these conditions, a deep red colour is produced, which is used as a colorimetric test for iron in small quantities. The interfering action of the blue copper salts is overcome by the addition of a weak solution of potassium cyanide, which results in the formation of the colourless complex cyanide of copper and potassium.

Zinc and antimony do not interfere with the reaction, but lead must be removed as sulphate.

This method has been found to give very accurate results in cases where the percentage of iron in the copper alloys is so low that the ordinary gravimetric methods of estimation involve the use of a large quantity of the alloy.

264. "The effect of heat on the alkyl iodides." By Zelda Kahan.

Experiments on the effect of heating alkyl iodides alone and in the presence of zinc, sodium, silver chloride, and barium peroxide show that the probable course of the reaction is:

(1) The dissociation of the alkyl iodide into hydrogen iodide and an alkylene or alkylidene derivative.

(2) If alkylidene is formed, its conversion into an ethylene derivative.

(3) The reduction of the ethylene derivative by the hydrogen iodide. When heated alone, ethyl iodide yields ethane, ethylene, and a little hydrogen, but in the presence of zinc, butane is also formed in amount proportional to the quantity of zinc employed. Methyl iodide decomposes much less readily than any of the alkyl iodides, yielding chiefly methane and ethylene; with zinc, ethane is also formed, but with barium peroxide the chief products are carbon mono- and di-oxides and methane.

The normal and *iso*propyl iodides, when heated alone, yield only propane, but with zinc or sodium much propylene and some hydrogen are also formed.

265. "The influence of acids and alkalis on the velocity of formation of acetoxime." By Ernest Barrett and Arthur Lapworth.

At 0° and at a dilution of one gram-molecule each of acetone and hydroxylamine per 40 litres, the velocity of oxime formation is least with no other base or acid present. The acceleration caused by sodium hydroxide is very large and nearly proportional to the concentration of that substance. The acceleration caused by hydrochloric acid is also considerable, and rises rapidly until when half a gram-molecule of acid is present the velocity is more than fifty times as great as at first. With more acid, a very rapid fall occurs, and attains a nearly constant velocity when rather more than one gram-molecule of acid is present.

With acetaldehyde, very similar results were obtained.

The measurements were carried out before the appearance of Acree and Johnson's recent paper (*J. Amer. Chem. Soc.*, 1907, **38**, 258).

266. "Action of metallic calcium on ketones."

By Herbert Drake Law and Frederick Mollwo Perkin.

When metallic calcium is placed in contact with acetone which has previously been dried over calcium chloride, a slow evolution of hydrogen takes place, which becomes brisker in the course of a few hours. The rate of evolution of gas is about 2 litres in twenty-four hours at an average temperature of 16°. If the calcium and acetone are allowed to remain in contact for about one week and the product then fractionated, about 200 to 300 grams of mesityl oxide are obtained from 2 litres of acetone. More complex substances are also formed in considerable amount. If the acetone remaining after fractionation is again placed in contact with the same quantity of calcium, a further yield of mesityl oxide is obtained. The proportions for which the best results have been obtained are about 150 grams of metallic calcium and 2 litres of acetone. After standing for four days, 200 to 300 grams of mesityl oxide are obtained. When acetone is heated with metallic calcium, it is difficult to stop the reaction at the right point to obtain mesityl oxide, and products of high boiling point are formed.

Methyl ethyl ketone reacts very much more slowly with calcium, and the substances require to be left in contact for several months. When 1500 c.c. of methyl ethyl ketone are allowed to remain in contact with 200 grams of calcium for about one week, the rate of evolution of hydrogen is about 1 litre in twenty-four hours. On fractionation, at the end of eight to ten weeks, a considerable quantity of a fraction boiling at 164—165° is obtained, and also a larger quantity of fractions boiling up to 300°. The lower fraction is probably *γ-methyl-*Δ^{γ}*-heptene-ε-one*,

$$CH_3\cdot CH_2\cdot C(CH_3)\colon CH\cdot CO\cdot CH_2\cdot CH_3.$$

On oxidation with potassium permanganate, acetic acid and methyl ethyl ketone are obtained. This does not actually prove the correctness of the formula just given, because the same results would be obtained by oxidation of the compound:

$$CH_3\cdot CH_2\cdot C(CH_3)\colon C(CH_3)\cdot CO\cdot CH_3.$$

The substance is a colourless liquid, having a very fragrant odour resembling that of oil of bergamot.

267. "The so-called 'tetrabromodiphenoquinone' and the constitution of coerulignone."

By James Moir.

The author has continued his researches on Magatti's tetrabromodiphenoquinone (*Proc.*, 1906, 22, 110), and has studied the action of reducing agents on this compound.

268. "A note on certain pyrogenic reactions." By Norman Thomas Mortimer Wilsmore and Alfred Walter Stewart.

In the course of some investigations on the effect of a white-hot platinum wire on various organic substances, the authors have made the following observations. The apparatus employed was in essentials the same as the generator used in the case of keten (*Trans.*, 1907, **91**, 1938). The results obtained were qualitative only, no analysis being made.

Owing to its possible use as a solvent, the behaviour of benzene was investigated; it was not affected by the wire, and toluene also was unacted on.

When ethyl crotonate is treated pyrogenically, ethylene is liberated, and crotonic acid crystallises from the cooled liquid which remains in the generator. An unsaturated acid, namely, cinnamic, was then tried in benzene solution, but no effect was observed. On the other hand, when saturated ethereal salts were placed in the generator, a mixture of carbon dioxide and hydrocarbons was liberated. The decomposition, in the case of ethyl acetate, appears to take place in the following steps

$$CH_3\cdot CO_2\cdot C_2H_5 \longrightarrow CH_3\cdot CO_2H + C_2H_4 \longrightarrow CH_4 + CO_2 + C_2H_4.$$

In the case of ethyl malonate, ethylene is first evolved, as in the foregoing case, and the malonic acid thus formed breaks down into carbon dioxide and acetic acid, which, in its turn, decomposes into methane and carbon dioxide. It is to be noted that whenever any acetyl derivative is formed in the course of any of these stages, some keten is in turn produced from it. In contradistinction to the behaviour of the fatty acids, benzoic acid in benzene solution was not noticeably attacked.

From these results, the authors conclude that the ethylenic linking in the α-position with respect to the carboxyl group tends to render the compound more stable with regard to this agent than is an ethane derivative. This view is, of course, supported by the fact that unsaturated hydrocarbons are more stable in the electric arc than saturated ones.

From acetone, keten was obtained, whilst substances of high boiling point, such as anethole and aniline, were decomposed with charring.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bolduan, *Charles Frederick.* Immune sera. A concise exposition of our present knowledge concerning the constitution and mode of action of antitoxins, agglutinins, hæmolysins, bacteriolysins, precipitins, cytotoxins, and opsonins. 2nd edition, rewritten. pp. viii + 154. New York 1907. (*Recd.* 10/12/07.)

From the Publishers: Messrs. John Wiley and Sons.

Cross, *Charles Frederick,* and **Bevan,** *Edward John.* A text-book of paper-making. 3rd edition, containing additional matter, and in part re-written, with collaboration of *J. F.* **Briggs.** pp. x + 411. ill. London 1907. (*Recd.* 20/12/07.) From the Author.

Pawlewski, *Bronisław.* Organiczna preparatyka chemiczna. pp. iv + 298 + iv. ill. Lwów 1908. (*Recd.* 19/12/07.) From the Author.

Rideal, *Samuel.* Sewage and the bacterial purification of sewage. 3rd edition. pp. xii + 355. ill. London 1906. (*Recd.* 18/12/07.)

From the Author.

Weston, *Frank Edwin.* A scheme for the detection of the more common classes of carbon compounds. 2nd edition. pp. viii + 95. ill. London 1907. (*Recd.* 16/12/07.) From the Author.

At the next Ordinary Meeting on **Thursday,** January **16th,** 1908, at **8.30** p.m., the following papers will be communicated:

"Colour and constitution of azo-compounds. Part II. The salts of *p*-hydroxyazo-compounds with mineral acids." By J. J. Fox and J. T. Hewitt.

"The oxidation of aromatic hydrazines by metallic oxides, permanganates, and chromates." By F. D. Chattaway.

"Studies in fermentation. II. The mechanism of alcoholic fermentation." By A. Slator.

"Organic derivatives of silicon. Part IV. The sulphonation of benzylethylpropylsilicyl oxide and of benzylethyldipropylsilicane." By H. Marsden and F. S. Kipping.

"The formation and reactions of imino-compounds. Part VI. The formation of derivatives of hydrindene from dicyano-*o*-xylene." By C. W. Moore and J. F. Thorpe.

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Redwood, Sir Boverton ...	5	5	0
Rée, Alfred	10	0	0
Reynolds, J. Emerson... ...	1	1	0
Rideal, S.	1	1	0
Robertson, W.	0	5	0
Rogerson, H.	0	10	0
Roscoe, Sir Henry E. ...	2	0	0
Rosenheim, O.	1	1	0
Rücker, Sir Arthur	1	1	0
Ruhemann, S.	2	0	0
Russell, W. J.	2	2	0
Sadler and Co., Ltd. ...	5	5	0
Salamon, A. Gordon	5	5	0
Sand, H. J. S.	0	10	6
Scott, Alexander	2	2	0
Senier, Alfred	5	5	0
Shadwell, J. E. L.	5	0	0
Sharpe, James	5	5	0
Silberrad, O....	1	1	0
Smith, C. L. Lavers	5	5	0
Smith, N.	2	2	0
Smith, W. S.	0	10	6
Smithells, Arthur	2	2	0
Smithers, F. O.	1	1	0
Sowerby, F. H.	1	1	0
Spencer, Chapman, and Messel	105	0	0
Spiller, John	2	2	0
Spiller, W.	5	5	0
Spring, W.	1	0	0
Stallard, G.	1	1	0
Stead, J. E.	3	3	0
Stevenson, Sir Thomas ...	2	2	0
Struthers, R. J. de Fleming- ing-	1	0	0
Stuart, C. M....	2	2	0
Carried forward ...	£1987	10	6

	£	s.	d.
Brought forward ...	1987	10	6
Sutherland, D. A.	1	13	0
Symonds, W....	0	10	6
Teed, F. L.	1	1	0
Thomas, Charles	3	3	0
Thomas, H. E.	2	2	0
Thomson, William	1	1	0
Thorne, L. T.	3	3	0
Thorpe, J. F.	1	1	0
Thorpe, T. E.	5	5	0
Tilden, W. A.	2	2	0
Toms, F. Woodland	1	1	0
Tottenham and Edmonton Gas Co.	10	10	0
Townson and Mercer	5	5	0
Travers, M. W.	1	1	0
Turnbull, R. H.	0	15	0
Turner, A.	1	1	0
Tutton, A. E. H....	1	1	0
United Alkali Co.	21	0	0
United Turkey Red Co. Ltd.	50	0	0
Veley, V. H.	2	2	0
Voelcker, J. A. and E. W.	2	2	0
Wade, Frank	0	5	0
Wade, John	1	1	0
Walker, James	2	2	0
Walmsley, R. M.	1	1	0
Wardle and Sons, J. (Leek)	2	2	0
Wardle, Sir Thomas and Arthur H.	2	2	0
Warington, R.	1	1	0
Watney, Sir J.	2	2	0
Wellcome, H. S.	25	0	0
White, Sir W. H.	1	1	0
Whiteley, M. A.	1	1	0
Wilkinson, G. B....	2	2	0
Willcox, B.	2	2	0
Williams Bros. and Co. ...	26	5	0
Williamson, R.	10	10	0
Windschügl, Charles	1	1	0
Wood, Sir H. Trueman ...	1	1	0
Woodall, Corbett	5	5	0
Worrall, Henry	25	0	0
Wynne, W. P.	2	2	0
Young, George	1	1	0
Young, Sydney	3	3	0
Total	£2223	0	0

Total Subscriptions received from Great Britain and Ireland ... £2223 0 0

HOLLAND.

	£	s.	d.
Cohen, Prof. E.......	5	15	6
Franchimont, Prof.			
Holleman, Prof. A. F....			
Hoogewerff, Prof.			
Romburgh, Prof. P. Van			
Roozeboom, Prof. H. W. Bakhuis ...			
van Dorp, Dr. W. A.			

Total Subscriptions received from Holland £5 15 6

JAPAN.

	£	s.	d.
Doi, Kokichiro	1	1	0
Matsubara, Prof. K.	1	1	0
Matsura, Prof. A	1	1	0
Sakurai, Prof. Joji	1	1	0
Carried forward	£4	4	0

	£	s.	d.
Brought forward	4	4	0
Takamatsu, Dr. T.	1	1	0
Takayama, Dr. J.	1	1	0
Yoshitake, Prof. E.	1	1	0
	£7	7	0

	£	s.	d.
Total Subscriptions received from Japan	£7	7	0

SWITZERLAND.

	Fr.
Bellenot, Ch.	50
Berner Chemische Gesellschaft	43
Fichter, Professor F.	20
Geigy, J. R., Anilinfarben u. Extract-Fabrik, vorm.	200
Gesellschaft für Chemische Industrie	200
Gnehm, Professor R.	25
Gräbe, Professor	20
Hagenbach, Dr. Ed.	40
Hagenbach, Dr. H.	10
Kehrmann, Dr. F.	10
Klotz, E. Apotheker	5
Carried forward	Fr. 623

	Fr.
Brought forward	623
Kostanecki, Professor St. v.	20
Lunge, Professor	10
Mähly, Dr. J.	5
Nietzki, Professor R.	20
Nourisson, Ch.	5
Pictet, Professor A.	20
Rupe, Professor H.	20
Sandoz and Co., Chemische Fabrik vorm.	100
Tambor, Professor	5
Werner, Professor	20
Willstätter, Professor R.	25
Total	Fr. 873

	Fr.	
Total collected by Prof. H. Rupe	873.00	
Add Bank Interest received	14.10	
Total collected	Fr. 887.10	
Deduct expenses incurred on account of stationery and postages	28.00	
Total Subscriptions received from Switzerland	Fr. 859.10 =	£34 0 0

UNITED STATES OF AMERICA.

	$
Alden, John	10.00
Alexander, Jerome	5.00
American Dyewood Co.	100.00
Anderson, Geo. H. A.	5.00
Archbold, Geo.	10.00
Atteaux, F. E.	50.00
Ault and Wiborg	10.00
Austen, Peter T.	10.00
Baekeland, Dr. L.	100.00
Baskerville, Dr. Chas. F.	10.00
Barrett Mfg. Co.	500.00
Bancroft, Wilder D.	20.00
Berlin Aniline Works	150.00
Carried forward	$980.00

	$
Brought forward	980.00
Berolzheimer, Dr. D. D.	5.00
Bishop, Howard B.	5.00
Bloede, Victor G.	50.00
Bogert, M. T.	10.00
Booraem, J. V. B.	15.00
Bowman, Dr. Walker	15.00
Brawley, Margaret	2.00
Breneman, A. A.	5.00
Briggs, T. Lynton	20.00
Bruinier, A. G.	100.00
Burkard, Dr. E.	10.00
Campbell, J. H.	5.00
Carried forward	$1222.00

	$
Brought forward	1222.00
Cassella Colour Co.	500.00
Cathcart, Dr. W. R.	2.00
Chandler, Dr. Chas. F.	250.00
Central Dyestuff and Chemical Co.	25.00
Coblentz, Dr. Virgil	25.00
Consolidated Gas Co.	100.00
Continental Colour and Chemical Co.	500.00
Crane, F. D.	5.00
Danker and Marston	25.00
Dennis, L. M.	10.00
Doremus, Chas. B.	10.00
Dreyfus, L. A.	5.00
Dreyfus, Dr. W.	10.00
Drummond, I. W.	10.00
Earle and Co.	25.00
Elliot, A. H.	50.00
Engelhard, Dr. Chas.	10.00
Evans, P. N.	5.00
Frasch, Herman	250.00
Fries Brothers	100.00
Fiebiger, Peter	30.00
Fortner, L. B.	25.00
Fuerst, W. F.	25.00
Geigy Aniline and Extract Co.	100.00
Geisenheimer, Theo., and Bros.	50.00
General Chemical Co.	500.00
Gibbs, A. E.	5.00
Gifford, Livingston	100.00
Goldschmidt, S. A.	50.00
Goldsmith, B. B.	25.00
Grasselli Chemical Co.	250.00
Gudemann, Dr. Edw.	25.00
Hall, C. M.	50.00
Hart, Edward	15.00
Hasslacher, Jacob	50.00
Heller and Merz	250.00
Hemingway, Frank	5.00
Herreshoff, J. B. F.	50.00
Hesse, Bernard	25.00
Heyden Chemical Works ...	100.00
Hillebrand, W. F.	10.00
Hine Bros.	10.00
Hodgen, Walter	5.00
Hoffmann, W. F.	15.00
Holliday, Read and Co.	50.00
Hooker, Samuel C.	10.00
Howe, C. A.	10.00
Howe, H. M.	5.00
Jayne, Harry W.	50.00
Joyce, C. M.	10.00
Kahn, Julius	5.00
Kalle and Co.	100.00
Kaufmann, H. M.	10.00
Kinnicutt, Leonard P.	15.00
Koch, Geo. W.	3.00
Kohnstamm and Co.	50.00
Krebs, H. J.	10.00
Kunz, Dr. Geo. F.	10.00
Carried forward	$5247.00

	$
Brought forward	5247.00
Langmuir, A. C.	5.00
Lenher, V.	5.00
Lesser, Wm.	25.00
Levi, Emil	25.00
Levinstein, Edgar	50.00
Lieber, Hugo	50.00
Little, A. D.	20.00
Loeb, Morris	50.00
Low, Hon. Seth	25.00
Maas and Waldstein Co.	50.00
Mabery, C. F.	10.00
McCay, L. W.	20.00
McKelvey, J. Wm.	5.00
McKenna, Dr. Chas. F.	5.00
McMurtrie, Dr. Wm.	25.00
McVicker, W. B.	30.00
Mallet, J. W.	5.00
Mathews, Dr. Jno. A.	25.00
Matthews, J. M.	5.00
Metz, H. A. and Co.	500.00
Miner, H. S.	5.00
Mitchell, A. S.	5.00
Niagara Electrochemical Co. ...	100.00
Nichols, Dr. Wm. H.	500.00
Noyes, Wm. A.	5.00
Pacific Coast Borax Co. ...	50.00
Parker, T. J.	15.00
Parsons, Chas.	5.00
Pennock, J. D.	10.00
Phillips and Co.	10.00
Pitman, J. R.	2.00
Plaut, Albert	100.00
Pollmann, H.	5.00
Pough, F. H.	15.00
Raegener, Louis C.	25.00
Richards, Jos. W.	20.00
Richardson, Clifford	25.00
Robinson, C. J.	5.00
Roessler, Franz	50.00
Roessler and Hasslacher Chemical Co.	100.00
Rogers, Allen D.	10.00
Rosengarten, George	50.00
Rosenheim, Dr. P. J.	5.00
Sadtler, S. P.	10.00
Salis, von Dr. E.	10.00
Schieffelin, Dr. Wm. J. ...	100.00
Schniewind, Dr. F.	50.00
Schweitzer, Dr. H.	25.00
Seaman, Professor Wm. H. ...	5.00
Siegle, G. and Co.	50.00
Sjostrom, W. L.	5.00
Smith, Edgar F.	25.00
Society of Chemical Industry (New York Section). Contribution for Entertainment Fund of New York	1,000.00
Springer, Dr. Alfred	10.00
Spurge, E. C.	20.00
Stewart, Carter F.	5.00
Carried forward	$8614.00

	$
Brought forward	8614.00
Stone, Geo. C.	25.00
Stone, I. F.	100.00
Sykes, Walter F., and Co. ...	100.00
Talbot, Henry P.	10.00
Talbot, Miss Marion	1.00
Taylor, Edw. R.	5.00
Toch, Henry M.	50.00
Toch, Max.	50.00
Uhlig, E. C.	10.00
Von Isakovics, Alois	25.00
Wagner, Dr. T. B.	25.00
Waldman, Louis I.	100.00
Carried forward	$9115.00

	$
Brought forward	9115.00
Walker, W. H.	10.00
Whitaker, M. C.	5.00
Wiener, William	3.00
Wilke, Dr. Wm.	5.00
Wittmack, Dr. C. A.	10.00
Woodman, Dr. D.	5.00
Wrampelmeier, T. J.	10.00
Wulling, Fred. Dean	5.00
Zabriskie, C. B.	25.00
Zerban, Fritz	5.00
Zinsser, F. G.	50.00
Total	$9248.00

Proportion of the American Subscriptions transmitted to the English Fund		£400 0 0
Add Subscriptions sent direct to the Fund in London :—		
Dr. G. Archbold	£3 0 0	
Dr. L. H. Baekeland	5 0 0	
Dr. C. F. Chandler	10 0 0	
Dr. W. H. Nichols	50 0 0	
		68 0 0
Total Subscriptions received from America		£468 0 0

Perkin Memorial Fund.

Cr.

	£	s.	d.	£	s.	d.
Subscriptions—						
Austria	10	7	10			
France	250	5	3			
Germany	554	15	0			
Great Britain and Ireland	2,223	0	0			
Holland	5	15	6			
Japan	7	7	0			
Switzerland	34	0	0			
United States of America	468	0	0			
				3,553	10	7
Interest on Deposit				59	12	4
Sale of 270 copies of Report				14	8	9
Total				3,627	11	8

Dr.

	£	s.	d.	£	s.	d.
Mr. Cope for portrait				420	0	0
Mr. Pomeroy for bust				159	5	0
Printing				65	4	8
Postage and telegrams				26	5	5
Travelling expenses, cabs, etc.				8	13	10
Distribution of circulars				19	12	2
Typing and translations				1	17	1
Stationery, parcels, etc.				3	19	1
Expenses of Mansion House Meeting				3	0	6
Fees and gratuities at Royal Institution				1	10	0
Bank charges				3	0	0
Sundries					17	6
Issue of Report:						
"Times" for printing	120	0	0			
Engraving plates	64	7	7			
Advertising	8	12	6			
Distribution in England	12	18	2			
,, ,, Germany	1	3	0			
,, ,, France		8	6			
Postage and sundries	2	13	0			
				210	2	9
Handed over to the Treasurer of the Chemical Society on behalf of the Research Fund				2,704	3	8
Total				3,627	11	8

RAPHAEL MELDOLA, *Chairman* } Perkin Memorial Fund.
A. G. GREEN, *Hon. Secretary* }

I have examined the above Account with the Books and Vouchers of the Perkin Memorial Fund and certify it to be in accordance therewith.

W. B. KEEN, *Chartered Accountant.*
23, Queen Victoria Street, E.C.

21*st November*, 1907.

Richard Clay and Sons, Limited,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

LIST

OF THE

OFFICERS AND FELLOWS

OF THE

CHEMICAL SOCIETY.

CORRECTED TO AUGUST, 1907.

BURLINGTON HOUSE,
LONDON, W.
1907.

OFFICERS AND COUNCIL,

ELECTED MARCH 22nd, 1907.

PRESIDENT.

SIR WILLIAM RAMSAY, K.C.B., LL.D., F.R.S.

VICE-PRESIDENTS

WHO HAVE FILLED THE OFFICE OF PRESIDENT:

HENRY EDWARD ARMSTRONG, Ph.D., LL.D., F.R.S.
ALEXANDER CRUM BROWN, D.Sc., LL.D., F.R.S.
Sir WILLIAM CROOKES, D.Sc., F.R.S.
Sir JAMES DEWAR, M.A., LL.D., F.R.S.
AUGUSTUS GEORGE VERNON HARCOURT, M.A., D.C.L., F.R.S.
RAPHAEL MELDOLA, F.R.S.
HUGO MÜLLER, Ph.D., LL.D., F.R.S.
WILLIAM ODLING, M.A., M.B., F.R.S.
JAMES EMERSON REYNOLDS, Sc.D., M.D., F.R.S.
Sir HENRY ENFIELD ROSCOE, LL.D., F.R.S.
WILLIAM JAMES RUSSELL, Ph.D., F.R.S.
THOMAS EDWARD THORPE, C.B., LL.D., F.R.S.
WILLIAM AUGUSTUS TILDEN, D.Sc., F.R.S.

VICE-PRESIDENTS:

JAMES JOHNSTON DOBBIE, M.A., D.Sc., F.R.S.
RUDOLPH MESSEL, Ph.D.
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WILLIAM HENRY PERKIN, Ph.D., F.R.S.
ARTHUR SMITHELLS, B.Sc., F.R.S.
WILLIAM PALMER WYNNE, D.Sc., F.R.S.

TREASURER:

ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

SECRETARIES:

MARTIN ONSLOW FORSTER, D.Sc., Ph.D., F.R.S.
ARTHUR WILLIAM CROSSLEY, D.Sc., Ph.D., F.R.S.

FOREIGN SECRETARY:

HORACE TABBERER BROWN, LL.D., F.R.S.

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GEORGE THOMAS BEILBY, F.R.S.
BERNARD DYER, D.Sc.
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HOOPER ALBERT DICKINSON JOWETT, D.Sc.
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JOHN WADE, D.Sc.

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JOHN CANNELL CAIN, D.Sc.

SUB-EDITOR OF THE SOCIETY'S JOURNAL:

ALFRED JOHN GREENAWAY.

ASSISTANT SUB-EDITOR:

CECIL HENRY DESCH, D.Sc., Ph.D.

ASSISTANT SECRETARY:

STANLEY ERNEST CARR.

LIBRARIAN:

FRANCIS WILLIAM CLIFFORD.

COMMITTEES, 1907–8.

Sir William Ramsay (President), Dr. A. Scott (Treasurer), Dr. M. O. Forster and Prof. A. W. Crossley (Hon. Secretaries), and Dr. Horace T. Brown (Foreign Secretary), are *ex officio* members of each Committee.

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Messrs. E. G. Hooper, G. T. Moody, T. E. Thorpe, W. A. Tilden, and the Officers.

HOUSE COMMITTEE.

Messrs. W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. Millar Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

LIBRARY COMMITTEE.

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RESEARCH FUND COMMITTEE.

Messrs. G. T. Beilby, W. R. Dunstan, P. F. Frankland, A. D. Hall, G. Matthey, R. Messel, H. Müller, W. H. Perkin, S. P. U. Pickering, W. A. Tilden, and the Officers.

The Ordinary Scientific Meetings for 1907-8 will be held on the following Thursdays at 8.30 p.m. :—

October 24th, 1907
November 7th, ,,
,, 21st, ,,
December 5th, ,,
,, 19th, ,,
January 16th, 1908
February 6th, ,,
,, 20th, ,,

March 5th, 1908
,, 19th, ,,
April 2nd, ,,
May 7th, ,,
,, 21st, ,,
June 4th, ,,
,, 18th, ,,

Annual General Meeting, Thursday, March 26th, 1908, at 5 p.m.

Society's Bankers:

Messrs. COUTTS & CO., 440, Strand, W.C.

Telephone No.: 1368, Mayfair.

THE CHEMICAL SOCIETY.

The Chemical Society was founded on February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice thereof from the Secretaries.

Each Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications so long as his Annual Subscription be not in arrear. He is also entitled to the use of the books in the Society's Library, under such restrictions as the Council may deem necessary. He has the privilege of introducing to Ordinary Meetings of the Society, two visitors, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

When elected, every Candidate previous to admission is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due

on the first day of January of every year. The life composition fee is £30, excepting that Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If a Candidate be elected during the month of November or December, he will not be called upon to pay any annual subscription for the current year, and will not be entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March owes two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, shall cease to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have decided that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. Papers which, on the report of referees, are deemed by the Council unsuitable for publication in the Transactions, are deposited in the Society's Archives. In all cases, an abstract of the paper, not exceeding three hundred words in length, should be supplied for insertion in the Proceedings.

Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

PUBLICATIONS OF THE SOCIETY.

With the exception of a few numbers of the Journals and Proceedings which are out of print, the following publications may be obtained from Messrs. Gurney and Jackson, 10, Paternoster Row, E.C. :

		Price to Fellows.			Price to Public.		
		£	*s.*	*d.*	£	*s.*	*d.*
Memoirs and Proceedings, 1841-1847 (3 Vols.) ...	per vol.	1	0	0	1	10	0
Quarterly Journal, 1848-1862 (14 Vols.)...	per vol.	1	0	0	1	10	0
,, ,, ,, ,, (Single Parts)	per part		5	0		7	6
Journal, 1862–1895	per vol.	1	10	0	1	10	0
,, ,, ,, (Single Parts)	per part		2	6		2	6
,, 1896 to present date	per vol.	2	0	0	2	0	0
,, ,, ,, (Single Parts)	per part		3	6		3	6
Proceedings, 1885 to present date	per vol.		7	6		7	6
,, ,, ,, (Single Parts) ...	per part			6			6
Annual Reports on the Progress of Chemistry (bound in cloth), Vols. I (1904), II (1905), III (1906)... ...	per vol.		4	6		4	6
Collective Index, Vol. I. 1841–1872	per vol.		4	0		4	0
* ,, ,, ,, II. 1873–1882	per vol.		10	0		15	0
* ,, ,, ,, III. 1883–1892	per vol.		15	0	1	0	0
* ,, ,, ,, IV. 1893–1902	per vol.	1	0	0	1	10	0
†Jubilee Volume, 1891...			6	0		6	0
†Memorial Lectures, 1893-1900			7	6		7	6
†Library Catalogue, 1886			1	0		1	0
,, ,, 1903			2	6		2	6
†Cases for binding the Journal in 4 vols....	per year		4	0		4	0
Tables of International Atomic Weights (as recommended by the International Atomic Weights Committee). 1/6 per doz. ; 12/- per hundred.							

* Postage to Fellows One Shilling extra.
† Post free to Fellows.

The *Journal*, which is published on the last day of each month, includes the Transactions of the Chemical Society and Abstracts of chemical papers published in other Journals.

The *Proceedings* contain certain papers read at the meetings and abstracts of the remainder and of the discussions. They are, as a rule, issued to the Fellows about a week after each Ordinary Meeting.

The Annual Reports on the Progress of Chemistry contain an epitome of the principal definite steps in advance which have been made during the year. Fellows can obtain, from the Assistant Secretary, cases for binding the Annual Reports, price One Shilling each.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. In future the income accruing from the recent munificent donations received from the Goldsmiths' Company and from the Perkin Memorial Fund will be devoted as far as possible to the encouragement of research in (*a*) metallurgical and inorganic chemistry and (*b*) the chemistry of coal-tar products, respectively.

The Committee meets twice a year to consider applications for grants; and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

NAMES OF HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. Svant August, Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
May 18, 1904	Becquerel, Prof. Antoine Henri, LL.D. (Aberd.), 6, Rue Dumont d'Urville, XVI. Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. Stanislao, F.R.S., Reale Università, Rome
May 18, 1904	Clarke, Prof. Frank Wigglesworth, LL.D. (Aberd.), United States Geological Survey, Washington, D.C., U.S.A.
May 18, 1904	Curie, Madame Marie, La Sorbonne, Paris
Jan. 20, 1898	Curtius, Geh. Rath Prof. Dr. Theodor, Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. Emil, Aschaffenburg, Germany
June 16, 1892	†Fischer, Geh. Rath Prof. Dr. Emil, F.R.S., Hessischestrasse 1, Berlin, N, Germany
Feb. 1, 1883	Fittig, Prof. Dr. Rudolph, Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. Antoine Paul Nicolas, Rapenburg 104, Leyden
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Westendstrasse 28, Frankfurt am Main, Germany
Feb. 2, 1888	Hoff, Prof. Dr. Jacobus Henricus van't, F.R.S., Lietzenburgerstrasse 54, Berlin, 15, W.
Jan. 20, 1898	Körner, Prof. Wilhelm, R. Scuola superiore d'agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath Prof. Dr. Albert, Kaiser Wilhelmstrasse 108, Breslau
Feb. 2, 1888	Landolt, Geh. Rath Prof. Dr. Hans, Kaiserallee 222, Berlin, W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Mölkerbastei 5, Vienna I.
May 18, 1904	Liebermann, Geh. Rath Prof. Dr. Carl, Matthäikirchstrasse 29, Berlin, W.
May 18, 1904	Morley, Prof. Edward Williams, West Hartford, Conn., U.S.A.

* Faraday Lecturer, 1872.
† Faraday Lecturer, 1907.

Date of Election.	
Jan. 20, 1898	*Ostwald, Geh. Rath Prof. Dr. Wilhelm, LL.D. (Aberd.), Grossbothen, Kgr., Sachsen
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Théophile, Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. Walthère, Rue Beckmann 32, Liége
May 18, 1876	Thomsen, Prof. Dr. Julius, F.R.S., Lindevei 13, Copenhagen
Jan. 20, 1898	Troost, Prof. Louis Joseph, Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. Johannes Diderik van der, T.C., Hooftstraat 117, Amsterdam

* Faraday Lecturer, 1904.

FARADAY LECTURERS.

1869. Jean Baptiste André Dumas.
1872. Stanislao Cannizzaro.
1875. August Wilhelm von Hofmann.
1879. Charles Adolphe Wurtz.
1881. Hermann Ludwig Ferdinand von Helmholtz.
1889. Dmitri Ivanovitsch Mendeléeff.
1895. Lord Rayleigh.
1904. Wilhelm Ostwald.
1907. Emil Fischer.

LONGSTAFF MEDALLISTS.

1881. Thomas Edward Thorpe.
1884. Cornelius O'Sullivan.
1888. William Henry Perkin.
1891. Francis Robert Japp.
1894. Horace Tabberer Brown.
1897. William Ramsay.
1900. William Henry Perkin, junr.
1903. William Jackson Pope.
1906. Walter Noel Hartley.

In order that the List of Fellows may be as complete as possible, those Fellows whose names and degrees do not appear in full are requested to communicate with the Assistant Secretary. Inaccuracies should be reported without delay.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society; V.P. as Vice-President;
S. as Secretary; T. as Treasurer; F.S. as Foreign Secretary; P. as President.

Date of Election.			
1906			Abegg, Richard, Prof., Ph.D. (Berlin), Landsbergstrasse 4, Breslau, Germany
1903	Trans.		Abell, Robert Duncombe, D.Sc. (Wales), Ph.D. (Leipzig), F.I.C., University College of South Wales and Monmouthshire, Cardiff
1871	Trans.	C. 1882-4	Abney, Sir William de Wiveleslie, K.C.B., Hon. D.C.L. (Dun.), Hon. D.Sc. (Vict.), Sc.D. (Dub.), F.R.S., F.I.C., Rathmore Lodge, Bolton-gardens-south, S.W.
1883			Abraham, Alfred Clay, F.I.C., 87, Bold-street, Liverpool
1890			‖Abrines, Gustavus Anthony, Sanitary Commissioner's Office, Gibraltar
1904			Ackroyd, John Prest, B.Sc. (Lond.), 116, Richmond-street, Accrington, Lancs.
1875	Trans.		Acworth, Joseph John, Ph.D. (Erlangen), F.I.C., Thornbank, Shootup-hill, Brondesbury, N.W.
1905			Adam, Adam Lawson Kelly, 296 Bath-street, Glasgow
1892			Adams, Arthur, F.I.C., Kelvin House, Edgbaston-road, Smethwick
1877	Trans.		‖Adams, Matthew Algernon, F.R.C.S. (Eng.), F.I.C., The Kulm, Bearsted, near Maidstone
1901			Adams, Ormsby Gore, School of Mines, Thames, Auckland, New Zealand
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helens, Lancs.
1896			Addie, Robert, Messrs. Kennedy and Addie, Norfolk House, Laurence Pountney Hill, E.C.
1881	Trans.		Adeney, Walter Ernest, Hon. D.Sc. (R.U.I.), A.R.C.S.I., F.I.C., Royal University of Ireland, Earlsfort-terrace, Dublin
1885	Trans.		Adie, Richard Haliburton, B.Sc. (Lond.), M.A. (Cantab.), 136, Huntingdon-road, Cambridge
1885			Adriance, John Sabine, Ph.D., The Union League Club, New York, U.S.A.

Date of Election.		
1906		Agar, Shelton Gottlieb, Panorama House, Guernsey, Channel Islands
1905	Trans.	Ahlum, Charles Chester, c/o Messrs. G. W. Lord and Co., Philadelphia, Pa., U.S.A.
1901		Aitken, Andrew Charles, c/o The Burma Oil Co., Ltd., Rangoon, Burma
1879		Albright, George Stacey, M.A. (Cantab.), Bromesberrow-place, Ledbury
1893		Albuquerque, John Pedrozo d', Prof., M.A. (Cantab.), F.I.C., Government Laboratory, Barbados, West Indies
1885		Alcock, Frank Harris, F.I.C., 9, Broad-street Corner, Birmingham
1892		Alcock, John While, Central Brewery, 45, Mott-street, Birmingham
1902		Alder, John Frederick, 28, Claverly-grove, Church End, Finchley, N.
1903		Alderton, Gilbert John, B.Sc. (Lond.), F.I.C., The Nest, Eglinton-road, Plumstead, Kent
1888	Proc.	Alexander, John, M.A. (Glas.), Midfield, Perth
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, 55, Northern-grove, West Didsbury, near Manchester
1907		Allan, John Campbell, 91, Norse-road, Scotstoun, Glasgow
1907		Allen, Alfred Frederick, B.Sc. (Lond.), 35, Purrett-road, Plumstead, S.E.
1894		Allen, Frederick John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, Frederick Thomas, B.Sc. (Dun.), 32, Currock-terrace, Carlisle
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1904		Allen, William Harold Richard, c/o Straits Trading Co., Butterworth, Penang, Straits Settlements
1894		Allibon, George Henry, Mayfield, Lisburn-road, Balmoral, Belfast
1905		Allison, James Albert, Luchana Laboratory, Apartado 45, Bilbao, Spain
1899		Allworthy, James Herbert, Emanuel School, Wandsworth Common, S.W.
1899		‖Allworthy, Samuel William, M.A., M.D., B.Ch. (Dub.), The Manor House, Antrim-road, Belfast
1903		Alton, William Lester St. John, F.I.C., 11, Briar-walk, Putney, S.W.
1905	Trans.	Amos, Arthur, B.A. (Cantab.), South-Eastern Agricultural College, Wye, Kent
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. (Oxon.), 3, Union-place, Worthing

Date of Election.			
1890			Anderson, Frederic Alfred, B.Sc. (Lond.), F.I.C., 31a Clanricarde-gardens, W.
1895			Anderson, Herbert, Royal Latin School, Buckingham
1900			Anderson, James William, The Paddock, Halling, near Rochester
1906			Anderson, Robert, Chester-road-west, Sunderland
1901	Trans.		Anderson, William Carrick, M.A., D.Sc. (Glas.), 8, Windsor-quadrant, Kelvinside, Glasgow
1892			Anderson, William Smellie, c/o G. Anderson, Esq., 68, Culverley-road, Catford, S.E.
1905	Trans.		Andrews, Albert Edward, St. Hilda, 20, Carew-road, Thornton Heath, Surrey
1888			Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882			Andrews, Launcelot Winchester, Ph.D. (Göttingen), 3731, Westminster-place, St. Louis, Mo., U.S.A.
1905	Trans.		Angel, Andrea, M.A. and B.Sc. (Oxon.), 17, Banbury-road, Oxford
1877			Angell, John, F.I.C., 6, Beacon's-field, Derby-road, Withington, Manchester
1898	Trans.		Annable, Henry William Coupe-, Tungsten and Rare Metals Co., Ltd., Queen's-road, Battersea, S.W.
1905			Anthony, Charles, jun., M.Inst.C.E., Casilla de Correo, 95, Bahia Blanca, Argentine, South America
1879			‖Appleby, Herbert, 2, John Dalton-street, Manchester
1903			Appleyard, George Henry, F.I.C., Wilmington Oil Mills, 151, Cleveland-street, Hull
1890	Trans.		Appleyard, James Robert, Royal Technical Institute, Salford
1903			‖Appleyard, Percy, Albany, Western Australia
1884			Archbutt, Leonard, F.I.C., The Yews, Madeley-street, Derby
1875			Armistead, William, M.B., C.M. (Edin.), Stapleford, Cambridge
1900	Proc.		Armitage, Francis Paul, Colet House, Talgarth-road, West Kensington, W.
1903	Trans.		‖Armstrong, Edward Frankland, D.Sc. (Lond.), Ph.D. (Berlin), c/o Messrs. Huntley & Palmers, Reading
1900			Armstrong, Frederick William, 6, St. Thomas's-terrace, Wells, Somerset
1870	Trans.	C.1873-5 S. 1875-93 P.1893-5	‖Armstrong, Henry Edward, Prof., LL.D. (St. Andrews), Ph.D. (Lips.), F.R.S., 55, Granville-park, Lewisham, S.E., and Central Technical College, Exhibition-road, S.W.
1905			Arnaud, Francis William Frederick, F.I.C., The Town Hall, Portsmouth
1906	Trans.		Arup, Paul Seidelin, M.A. (Nova Scotia), 62, Haverstock Hill, N.W.
1894			Ashdown, Charles Henry, Monastery-close, St. Albans
1903			Ashdown, Herbert Henry, 3, Genesta-road, Plumstead, Kent
1900			Ashton, James, Hacken Sewage Works, Moses Gate, Bolton

Date of Election.			
1905			Ashwell, James Henry, 117, Waterloo-crescent, Nottingham
1897			Ashworth, John Bright, 11, The Promenade, Egremont, Cheshire
1901			Aspinall, Thomas, 62, Gilnow-road, Bolton
1900	Trans.		Aston, Bernard Cracroft, N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, William George, 12, Douglas-road, Goodmayes, Ilford, E.
1903			Atkinson, Harford Montgomery, B.Sc. (Wales), Ph.D. (Göttingen), 69, George-street, Limerick, Ireland
1872	Trans.		‖Atkinson, Robert William, B.Sc. (Lond.), F.I.C., 44, Stuart-street, Cardiff
1862	Trans.	C. 1874-8	‖Attfield, John, Prof., M.A. and Ph.D. (Tübingen), F.R.S., F.I.C., Ashlands, Watford, Herts.
1903	Trans.		Attwell, Herbert Moore, A.R.C.S., Stoke Hill House, Limpley Stoke, Bath
1872	Trans.		‖Attwood, George, M.Inst.C.E., Steyning Manor, Stogursey, Somerset; and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1903			Aubrey, Henry James, The Cross, Worcester
1895	Trans.		‖Auden, Harold Allden, Central Laboratory, United Alkali Co., Widnes, Lancs.
1886			Audley, James Aloysius, B.Sc. (Lond.), A.R.C.S., F.I.C., c/o Messrs. G. Howson and Sons, Eastwood Sanitary Works, Hanley, Staffs.
1877			Austen, Peter Townsend, Ph.D., 204, West 86th-street, New York, U.S.A.
1906	Trans		‖Austin, Percy Corlett, M.A. (Cantab.), Queen's College, Galway, Ireland
1892			Avery, David, Working Men's College, Melbourne, Australia
1896			Aykroyd, Henry Edward, Scaitcliffe, Queen's-road, Ilkley, Yorks.
1891			Aylan, John Charles, Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1903			‖Badcock, William Cornish, M.A. (Cantab.), The Grammar School, Crediton, Devon
1904			Baguley, Allan, B.Sc. (Wales), F.I.C., University College of North Wales, Bangor
1907			Bailey, Francis James, Findon Hill, Sacriston, Durham
1875	Trans.		‖Bailey, George Herbert, Ph.D. (Heidelberg), D.Sc. (Lond.), The University, Manchester; and Marple Cottage, Marple, Cheshire
1903			Bailey, Harold James, A.I.C., Maritime Coke Works, Pontypridd, S. Wales
1893			Bailey, Henry, 6, Elsenham-road, Wimbledon Park, S.W.
1900	Trans.		Bain, Alexander William, B.A., B.Sc. (Lond.), A.I.C., Fairlight, Muswell-rise, Muswell Hill, N.

Date of Election.			
1884			‖Bain, Daniel, United Alkali Co., Ltd., Allhusen's Works, Gateshead-on-Tyne
1891			Bairstow, John, Burley, Queen's-park, Chester
1901			Baker, Arthur, 103, Lynwood-avenue, Darwen, Lancs.
1889			‖Baker, Charles Frederic, B.Sc. (Lond.), Ph.D. (Strassburg), Technical College, Sunderland
1883	Trans.		‖Baker, Charles John, The Schools, Shrewsbury
1899			Baker, Clement Harrison, c/o Messrs. C. Harrold & Co., 2 and 3 St. Paul's-square, Birmingham
1907	Trans.		Baker, Frank, B.Sc. (Lond.), St. John's School, Eton
1902			Baker, Frederick Guy Stirling, Marryatt's Lodge, Snaresbrook, Essex
1900			Baker, Frederick Nolan, Lieut., R.A., R.A. Mess, Shoeburyness
1881	Trans.		Baker, Harry, F.I.C., Epworth House, Moughland-lane, Runcorn, Cheshire
1884	Trans.	C. 1899-03	‖Baker, Herbert Brereton, M.A., D.Sc. (Oxon.), F.R.S., Christ Church, Oxford
1893	Trans.		Baker, Julian Levett, F.I.C., Stainesbury Holt, Kingston-road, Staines
1901			Baker, Thomas Thorne, 7, St. James'-avenue, Cricklewood, N.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon
1902			Ball, James Handby, M.Sc. (L'pool), F.I.C., Rathbane Cottage, Limerick, Ireland
1901	Trans.		Ball, Walter Craven, B.A. (Oxon.), Guy's Hospital, S.E.
1907			Ball, William Robert, B.Sc. (Lond.), 48, Cambridge-road, Thornaby-on-Tees
1892			‖Ballantyne, Horatio, F.I.C., 75, Chancery-lane, W.C.
1896			Ballingall, William, M.A. (St. Andrews), Ardarrock, Dundee
1891	Trans.	C. 1905-	Baly, Edward Charles Cyril, F.I.C., University College, Gower-street, W.C.
1886			Bamber, Henry Kelway George, Ingress House, Greenhithe, Kent
1890	Proc.		Bamber, Montague Kelway, F.I.C., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1896			Banerjee, Gopal Chandra, Kaiser Soap Co., Cawnpore, India
1906			Banner, George Ernest, 10, Highfield-road, Rock Ferry, Cheshire
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, F.I.C., 59, Tregunter-road, S. Kensington, S.W.
1904	Trans.		Barbour, William, M.A. and B.Sc. (St. Andrews), Dalswinton, All Saints'-road, Peterborough
1905			Barbrook, George Henry, c/o Messrs. T. Prentice & Co., Stowmarket, Suffolk
1880			‖Barclay, Arthur Edward, 95, Farringdon-street, E.C.

Date of Election			
1903	Trans.		‖Barger, George, M.A. (Cantab.), D.Sc. (Lond.), The Wellcome Physiological Research Laboratories, Brockwell Hall, Herne Hill, S.E.
1906			Barker, Arthur Ernest, B.A., B.Sc. (Lond.), 3, York-road, Chorlton-cum-Hardy, Lancs.
1890			‖Barker, Joseph, Rev., M.A., and D.D. (Oxon.), St. Barnabas', Grimsby
1903	Trans.		Barker, Thomas Vipond, B.A. and B.Sc. (Oxon.), Mineralogical Dept., University Museum, Oxford
1896			Barker, William Henry, B.Sc. (Lond.), Addiscombe, Empress-avenue, Wanstead Park, Essex
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1897			Barlow, Herbert William Leyland, M.A. and M.D. (Oxon.), M.R.C.S. and L.R.C.P. (Lond.), D.P.H., (Cantab.), Holly Bank, Croftsbank-road, Urmston, Manchester
1897	Trans.		Barlow, William, The Red House, Stanmore, Middlesex
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W.; and Dynamite Works, Modderfontein, near Zuurfontein, S. Africa
1905			Barnes, James Hector, Prof., B.Sc. (Birm.), A.I.C., Government College of Agriculture, Lyallpur, Punjab, India
1875			‖Barnes, Richard Leburn, Phœnix Chemical Works, Hackney Wick, N.E.
1888			‖Barraclough, William Herbert, F.I.C., Mortomley, near Sheffield
1895			Barralet, Edgar Stuart, 6, Wellington-mansions, Queen's Club-gardens, W.
1891			Barratt, John Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward Louis, B.Sc. (Lond.), F.I.C., 12, Avenue de la Grande Armée, Paris
1906	Proc.		Barrett, Ernest, B.Sc. (Lond.), 56, Elswick-road, Lewisham S.E.
1901			Barrie, Thomas Stewart, 4, Newton-street, Charing-cross, Glasgow
1905	Trans.		Barrowcliff, Marmaduke, A.I.C., 69, Hatherley-road, Sidcup, Kent
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, John Anthony, Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc. (Virginia), Ph.D. (N. Carolina), College of the City of New York, New York City, U.S.A.
1864	Trans.	{C. 1870-3, 90-3}	‖Bassett, Henry, F.I.C., 26, Belitha-villas, Barnsbury, N.
1907	Trans.		Bassett, Henry, Jun., B.Sc. (Lond.), Ph.D. (Munich), D. ès Sc. (Nancy), F.I.C., The University, Liverpool
1891			Bate, William, Ladbroke, Hayle, Cornwall
1893			Bateman, John, c/o Messrs. J. C. and J. Field, The Marsh Lambeth, S.E.

Date of Election.			
1896			Bathurst, Charles, jun., B.A. (Oxon.), 3, Stone-buildings, Lincoln's Inn, W.C.
1905			Baxter, John George, c/o Mrs. Burgess, 143, Milton-road, Gravesend, Kent
1896			Bay, Lauritz Hansen, B.Sc. (Lond.), Deacon's School, Peterborough
1892			Bayliss, Charles, Mino, Castle Bromwich, near Birmingham
1906			Bayliss, William Heath, Brewery House, Ashwell, Herts.
1874			Bayly, Francis William, The Royal Mint, Sydney, N.S.W.
1903			Bayly, Harold Goodenough, F.I.C., Usine St. Madeleine, Trinidad, West Indies
1874			‖Bayne, James, 31, Vaughan-terrace, Harrow
1879			‖Bayne, William Thirlwall, LL.D. (Cantab.), Brockhill, Broadclyst, Exeter
1897			Beadle, Alec Alfred, Greenheys, Granville-road, High Barnet
1891	Trans.		Beadle, Clayton, Halewood, Sidcup, S.O., Kent
1861			‖Beadnell, Charles Edward, Major, R.A., Hafod, Llandinam, S.O., Montgomeryshire
1903			Beadnell, Charles Marsh, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Fleet Surgeon, 31, Matheson-road, West Kensington, W.
1867			Beale, William Phipson, K.C., M.P., 10, New-court, Carey-street, Lincoln's Inn, W.C.; and 2, Whitehall-court, S.W.
1905			Bealey, Edward Williams, B.A. (Cantab.), 11, Kildare-gardens, Bayswater, W.
1903			Beam, William, M.A., M.D. (Penn.), F.I.C., Chemical Laboratory, Gordon College, Khartoum, Soudan
1899			Bean, Percy, 17, Dickinson-street, Manchester
1902			Beanes, Alfred Edward, Falcon Works, Wallis-road, Hackney Wick, N.E.
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1896			Beardmore, George Russell, L.R.C.P. (Lond.), M.R.C.S. (Eng.), L.S.A., D.P.H. (Cantab.), Warwick House, Upper-street, Islington, N.
1901			Beaven, Edwin Sloper, 5, Boreham-terrace, Warminster
1890	Trans.		Beck, Charles Ridgeway, F.I.C., 33, Werter-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, F.I.C., 35, South Beach-road, Ardrossan, N.B.
1906			Beckett, Richard Henry, Prof., B.Sc. (Lond.), The College, Nagpur, C.P., India
1901			Bedford, Frederick, B.Sc. (Lond.), Ph.D. (Halle), 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, Peter Phillips, Prof., M.A., D.Sc. (Lond. and Dun.), B.Sc. (Vict.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1901			Bedwell, John Cardew, B.Sc. (Lond.), 65, High-street, Colchester

Date of Election.			
1905			Bees, William James, B.Sc. (Lond.), 43, Ash-grove, Hyde-park, Leeds
1900			Beesley, Frederick Arnold, B.Sc. (Lond.), 23, Whitmore-road, Beckenham, Kent
1872	Trans.	C. 1907-	‖Beilby, George Thomas, F.R.S., F.I.C., 11, University-gardens, Glasgow
1891			Belbin, Tom St. John, Capt., Nortonthorpe Hall, near Huddersfield
1888			Belcher, John Hope, B.A., B.Sc. (Lond.), Municipal Technical Institute, Coventry
1891			‖Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester Alexander, B.A., M.B. (Dublin), F.I.C., Brooklands, Dawlish, S. Devon
1889			Bell, Edward Wightman, High Bridge, Spalding
1899			Bell, Hugh Poynter, B.A. (Cantab.), 3, Mincing-lane, E.C.
1865	Trans.		‖Bell, J. Carter, A.R.S.M., F.I.C., The Cliff, Higher Broughton, Manchester
1889			‖Bell, Percy Carter, F.I.C., Milburn, New Jersey, U.S.A.
1906			Bell, William Edward, Langholm, Yarborough-road, Lincoln
1904	Trans.		Bellars, Albert Ernest, B.A. (Cantab.), Magdalene College, Cambridge
1905			Belton, Francis George, 16, Clarkson-street, Glossop-road, Sheffield
1879			Bemrose, Joseph, F.I.C., 56, St. Famille-street, Montreal, Canada
1874			‖Bendix, David, F.I.C., Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1902			Benham, Keith Benham, B.Sc. (Lond.), F.I.C., Dean's Hill, Stafford
1881			‖Benjamin, Marcus, A.M. (Lafayette), Ph.B. (Columbia), Ph.D. (Nashville), Sc.D. (Pennsylvania), U.S. National Museum, Washington, D.C., U.S.A.
1904			Benn, Robert Haslam Durward, West Mount, Montreal, Canada
1900			Bennett, Alexander Hutcheon, c/o Messrs. Ogston & Moore, Messina, Sicily
1904			Bennett, Charles Thomas, B.Sc. (Lond.), A.I.C., 57, Larkhall-rise, Clapham, S.W.
1903			Bennett, Colin Noël, 3, St. Laurence-cottages, Caterham, Surrey
1905			Bennett, Joseph, Windsor Printing Co., North Adams, Mass., U.S.A.
1892	Trans.		Bensusan, Arthur John, The Ouro Preto Gold Mines of Brazil, Ltd., Minas de Passagem, Ouro Preto, Brazil
1904			Bentley, Walter Henry, M.A. (Oxon.), Merton, Everton-road, Addiscombe, Croydon
1896	Trans.		Bentley, William Henry, B.Sc. (Vict.), 6, Woodbine-terrace, Irlam, near Manchester

Date of Election.			
1907			Benton, Frank Stanley, Hursthead, Reigate, Surrey
1890			Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1902	Trans.		Bergtheil, Cyril, Research Station, Sirseah, Mozufferpore Post Office, T. S. Railway, India
1900			Beringer, Heinrich Rowland, 11, Dolcoathe-road, Camborne, Cornwall
1882			‖Beringer, John Jacob, A.R.S.M., F.I.C., Basset-road, Camborne, Cornwall
1895	Trans.		Berkeley, The Rt. Hon. The Earl of, Foxcombe, Boar's Hill, Oxford
1890			‖Berncastle, Richard, 15, Ladbroke-gardens, Notting Hill Gate, W.
1893			Berridge, Douglas Jesse Penfold, M.A. (Oxon.), The Laboratory, Malvern College
1906			‖Berry, Arthur John, 5, University-gardens, Glasgow
1882			‖Berry, Edward Elhanan, F.I.C., 44, London Wall, E.C.
1907			Berry, Leslie Hamilton, B.Sc. (Lond.), A.I.C., Penshurst, Croham Park-avenue, S. Croydon
1899			Berry, Reginald Arthur, F.I.C., The West of Scotland Agricultural College, 6, Blythswood-square, Glasgow
1891			Berry, Thomas William, Education Office, Pentre, Rhondda, Glam.
1888	Proc.		Berry, William, 7, Hampton-park, Redland, Bristol
1906			Bethea, Oscar Walter, Prof., Missouri Medical College, Meridian, Miss., U.S.A.
1883	Trans.	{C. 1898-1900}	‖Bevan, Edward John, F.I.C., 3, New-court, Carey-street, W.C.
1886			Bevan, John William, F.I.C., Risedale, St. James-crescent, Swansea
1903			Beveridge, Wilfred William Ogilvy, Major, R.A.M.C., D.S.O., M.B. (Edin.), D.P.H. (Cantab.), R. Army Clothing Dept., Grosvenor-road, S.W.
1897			Bhaduri, Jyoti Bhushan, M.A. (Calcutta), Krishnaghur College, Krishnaghur, Dist. Nadia, Bengal, India
1903			Bhaduri, K., Prof., M.A. (Calcutta), Canning College, Lucknow, India
1903			Bibby, Charles Drake, 69, Queen's-road, Twickenham, Middlesex
1903			Bibby, Robert Gordon, York Hotel, Albemarle-street, W.
1865			‖Bickerdike, William Edward, F.I.C., Bryers Croft, Wilpshire, near Blackburn
1902			‖Bickford, Harding, 46, Currie-street, Adelaide, South Australia
1875			Biggart, John William, F.I.C., Chemical Laboratory, 29, Cathcart-street, Greenock
1872			Biggs, Charles Henry Walker-, 140, Salisbury-court, Fleet-street, E.C.
1881			Bingley, John, Northampton
1900			Binks, Frederick Nisbet, 35, Kenilworth-road, Monkseaton, Northumberland

Date of Election.		
1894		Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898		Birkett, Walter, 23, Carline-road, Lincoln
1906		Birt, Roderick Harold Capper, B.A. (Oxon.), St. Peter's College, Radley, Abingdon
1879		‖Black, Andrew Heggie, St. John's, Wakefield; and Moor Lodge, Harrogate
1904		Black, John Wyclif, 20, Mardale-crescent, Edinburgh
1902		Black, Walter Geoffrey, A.C.G.I., F.I.C., The Limes, New-street, Braintree, Essex
1886		Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1899	Trans.	Blackman, Walter Lionel, Mostyn, Thornlaw-road, West Norwood, S.E.
1903		Blackshaw, George Neville, B.Sc. (Wales), Government School of Agriculture, Elsenburg, Mulder's Vlei, Cape Colony, S. Africa
1899		Blackshaw, John Frank, The Midland Dairy Institute, Kingston Fields, Derby
1902		Blair, Herbert, Harton Lodge, Harton, South Shields
1901		Blake, George Stanford, 8, The Vineyard, Richmond, Surrey
1890	Trans.	Blake, Robert Frederick, F.I.C., Chemical Department, Queen's College, Belfast
1890		Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne
1875		‖Blanshard, Charles Thomas, M.A. (Oxon.), The Grammar School, Bewdley
1906		Blatchley, Charles Frederick Polwhele, B.A. (Oxon.), Downside College, Bath
1892		Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1902		Blenkinsop, Richard, c/o Messrs. May & Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1890		Blenkinsop, William Edmund Brandford, c/o Messrs. May and Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1903		Bliss, Henry James Wheeler, M.A. (Oxon.), c/o The Thames Varnish Co., Ltd., Island Wharf, Rainham, Essex
1899		Blofeld, Stuart, Rev., B.A., B.Sc. (Lond.), St. John's College, Battersea, S.W.
1896		‖Blood, Maurice, M.A. (Oxon.), 16, Alexandra-road, Kingston-on-Thames
1891		Bloomer, Frederick John, F.I.C., Penpont, Clydach, S.O., Glamorgan
1890	Trans.	Blount, Bertram, F.I.C., 76 and 78, York-street, Westminster, S.W.
1888		Bloxam, Arthur George, F.I.C., 105, Birkbeck Bank-chambers, Southampton-buildings, W.C.
1883	Trans.	‖Bloxam, William Popplewell, Prof., B.Sc. (Lond.), F.I.C., Clothworkers Research Laboratory, The University, Leeds

Date of Election.		
1903		Bluman, Nicholas John, c/o Messrs. Bluman & Stern, Ltd., Plough-bridge, Deptford, S.E.
1887		Blundstone, Edwin Richardson, B.A. (Cantab.), Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, Thomas Porter, M.A. (Oxon.), F.I.C., Tower-place, Shrewsbury
1896		Blyde, Joseph Edwin Alger, Merlin House, Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S. (Eng.), L.S.A. (Lond.), F.I.C., 26, Avenue-road, Regent's Park, N.W.
1892		Blyth, Meredith Wynter, B.A. (Cantab.), B.Sc. (Lond.), F.I.C., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, Arthur, Chemical Works, Stratford, E.; and Highstanding, Loughton, Essex
1902		Boardman, Ernest, B.Sc., (Vict.), 619, St. Helens-road, Bolton
1899		Boardman, Thomas Henry, B.A. (Cantab.), Christ's Hospital, West Horsham, Sussex
1878		Bodmer, Richard, F.I.C., Analytical Laboratory, 16, Southwark-street, S.E.
1899		Bogert, Marston Taylor, Prof., B.A. and Ph.B. (Columbia), Columbia University, New York City, U.S.A.
1906		Bogue, Thomas Going Stoney, 5, Kenilworth-square, Dublin
1869	Trans.	‖Bolas, Thomas, F.I.C., 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, Edward Richards, 16, Flanchford-road, Ravenscourt Park, W.
1899		‖Bond, Alfred Ernest, Peterbrook, Warstock, near Birmingham
1883		Bond, Henry Charles, Rev. M.A. (Oxon.), Belle Vue Hall, Brighton
1893	Trans.	‖Bone, William Arthur, D.Sc. (Vict.), Ph.D., F.R.S., West House, Lidgett-park-road, Roundhay, Leeds
1893		Boone, William Thomas, B.Sc. (Lond.), 6, Sydenham-villas, Cheltenham
1884		Borland, William Dalrymple, F.I.C., Beacon Lodge, Green Street Green, near Dartford, Kent
1881		‖Borns, Henry, Ph.D. (Greifswald), 5, Sutton Court-road, Chiswick, W.
1895		‖Borradaile, Lancelot Alexander, M.A. (Cantab.), Selwyn College, Cambridge
1861		‖Bosanquet, Robert Holford Macdowall, M.A. (Oxon.), F.R.S., Castillo Zamora, Realijo Alto, Teneriffe, Canary Islands
1894	Proc.	Bose, Chuni Lal, Prof., 24, Mohendra Bose's-lane, Calcutta
1881		Bostock, George Henry, 20, Lake-view-avenue, Toronto, Canada
1881	Trans.	Bothamley, Charles Herbert, F.I.C., Tangle Wood, Southside, Weston-super-Mare

Date of Election.		
1887	Trans.	Bott, William Norman, Ph.D. (Heidelberg), 16, St. Helens-place, E.C.
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1869		‖Bottomley, James Thomson, M.A., D.Sc., Hon. LL.D., (Glas.), F.R.S., 13, University-gardens, Glasgow
1886		Bottomley, William Beecroft, Prof., M.A. (Cantab.), Ph.D., 35, Downside-crescent, Hampstead, N.W.
1894		Boul, William Good, M.A. and LL.D. (Dub.), D.C.L. (Dun.), Tideswell Grammar School, near Buxton
1901		Bousfield, Edward George Paul, The Saxon Engineering Co., Ltd., Fenton, Stoke-on-Trent
1905	Trans.	Bousfield, William Robert, M.A. (Cantab.), K.C., St. Swithin's, Hendon
1891		Bovell, John Redman, Dodd's Botanical and Experimental Station, Barbados, West Indies
1865		‖Bowdler, Arthur Clegg, F.I.C., 20, Bank-terrace, Wellington-street, Blackburn
1888		Bower, Frank, c/o Messrs. Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, F.I.C., Messrs. Bowes and Sims, 40, Radford-street, Blackley, Manchester
1906		Bowis, William John, Ph.D. (Zürich), 97, North-road, West Bridgford, Notts.
1899		Bowles, Bertram Hennessey, Overdale, Eastwood-road, South Woodford, N.E.
1896		Bowley, Joseph John, 64, Redcliffe-gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, 4, Albert-square, Manchester
1862		Bowman, Frederic Hungerford, F.I.C., Assoc. Inst. C.E. and M.E., 4, Albert-square, Manchester
1896		‖Bowman, Herbert Lister, M.A. (Oxon.), Greenham Common, Newbury, Berks.
1894	Trans.	Boyd, David Runciman, Prof., D.Sc. (Glas.), Ph.D. (Heidelberg), F.I.C., The Hartley University College, Southampton
1901		Boyers, Henry, 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1903		Bradbury, Samuel, Ferncliff, Milton-grove, Globelands-road Ashton-on-Mersey, Cheshire
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Aberfeldy, Southwick, near Brighton
1876		‖Bradley, Nathaniel, Sunnyside, College-road, Whalley Range, Manchester
1888		Bradshaw, Charles, 169, Spring Vale-road, Sheffield
1906		Braid, Arthur Forbes, Rose Mount, Dumbreck, Glasgow

Date of Election.		
1894	Trans.	Brame, John Samuel Strafford, Royal Naval College, Greenwich, S.E.
1903		Branch, George Thomas, c/o Messrs. Strachan & Co., Chemists, Umtali, Rhodesia, South Africa
1904		Brand, Herbert Frank, M.A. (Lond.), 13, Clifton-road, Brockley, S.E.
1882		Branson, Frederic Woodward, F.I.C., 14, Commercial-street, Leeds; and Wynneholme, Far Headingley, Leeds
1882	Trans.	Brauner, Bohuslav, Prof., Ph.D. (Prague), Hon. D.Sc. (Manc.), New Chemical Laboratory, Bohemian University, Prague, VI., Bohemia
1896		Bray, Daniel, c/o W. Plowes, Esq., 45, Gothic-cottage, Old Goole, Goole, Yorks.
1905		‖Brettell-Vaughan, Edward Shipley Hewitt Edwards, 15, Queen-street, Cheapside, E.C.
1883		Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901		Bridges, Joseph Samuel, B.Sc. (Lond.), 45, Thistlethwaite-road, Clapton, N.E.
1904	Trans.	Bridgett, Robert Currie, M.A., B.Sc. (St. Andrews), Mackiston, Mitchell-drive, Rutherglen, Glasgow
1897		Brierley, James, 33 and 35, French-street, Southampton
1890	Trans.	Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston
1898		Brierley, Joseph, B.Sc. (Vict.), Ashton-road, Failsworth, Manchester
1893	Trans.	Briggs, John Frederick, 2, Frankfort-road, Herne Hill, S.E.
1906		Briggs, Richard Victor, Research Station, Sirseah, Mozufferpore P.O., T.S. Railway, Bengal, India
1905	Trans.	Briggs, Samuel Henry Clifford, B.Sc. (Vict.), Greenbank, Cleckheaton, Yorks.
1883		‖Briggs, Thomas Lynton, F.I.C., 188, Central-avenue, Flushing, L.I., U.S.A.
1884		‖Briggs, William, LL.D., D.C.L., M.A., B.Sc., Burlington House, Cambridge
1902		Brincker, John Augustus Herman, B.A., M.B., B.C. and D.P.H. (Cantab.), B.A. (Cape of Good Hope), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 57, Great Ormond-street, W.C.
1900		Britten, Frank Curzon, B.A. (Oxon.), Odiham School, Odiham, Hants.
1889		Broadbent, Harry, F.I.C., 187, Hyde Park-road, Leeds
1879		‖Broadbent, John James, F.I.C., Bank-street, Irvine, N.B.
1883		Brock, John, J.P., F.I.C., Gwern-Tyno, Colwyn Bay, N. Wales
1893		‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth
1898		Brooke, Arthur, M.A. (Cantab.), The Grammar School, Caistor, Lincs.

Date of Election.			
1900			Brooke, Charles Berjen, Colne House, Brantham, near Manningtree, Essex
1900			Brooke, John Richard, F.I.C., The Government Laboratory, Singapore, Straits Settlements
1906			Broome, James Spears, M.Sc. (Manc.), 18, Seedley-park-road, Pendleton, Manchester
1886	Trans		‖Brothers, Horace Edward, B.Sc. (Lond.), F.I.C., Annsville, Glenburn-park, Belfast
1884		C. 1895-8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, Prof., M.Sc. (Birm.), F.I.C., West Heath House, Northfield, Worcs.
1867	Trans.	C. 1872-4, V.P. 81-4, 90-1. P. 91-3	Brown, Alexander Crum, Prof., M.A., M.D. (Edin.), D.Sc. (Lond.), LL.D. (Aberd.), F.R.S., F.I.C., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, F.I.C., 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, c/o Messrs. W. Ropes and Co., St. Petersburg, Russia
1873	Trans.	C. 1881-3	‖Brown, Frederic Douglas, Prof., B.Sc. (Lond.), University College, Auckland, New Zealand
1884			Brown, Frederic William, Ingleside, 39, Loveday-road, West Ealing, W.
1892			Brown, George Fitz-, A.R.S.M., F.I.C., The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, Gerald Noël, 20, Cullum-street, E.C.
1880			Brown, Henry, F.I.C., Benskin's Brewery, Watford, Herts.
1871	Trans.	C. 1883-7, V.P. 94-7, 1904-7 T. 1903-04 F.S. 1907-	†Brown, Horace Tabberer, LL.D. (Edin.), F.R.S., F.I.C., 52, Nevern-square, Kensington, S.W.
1867	Trans.		‖Brown, James Campbell, Prof., D.Sc. (Lond.), Hon. LL.D. (Aberd.), F.I.C., 8, Abercromby-square, Liverpool
1905			Brown, John Coggin, B.Sc. (Dun.), H.M. Geological Survey, Calcutta, India
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1892			Brown, Reginald Busby, c/o The Badische Co., Ltd., 2, Samuel Ogden-street, Manchester
1884			Brown, William George, Prof., Ph.D. (N. Carolina), B.S. (Virginia), University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, Charles Edward, B.Sc. (Lond.), Christ's Hospital, West Horsham, Sussex
1893			Browne, Frank, Government Civil Hospital, Hong Kong, China

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† Longstaff Medallist, 1894.

Date of Election.		
1873		Brownen, George, Grove-road-east, Avon-park, Christchurch
1899	Trans.	Browning, Kendall Colin, Prof., M.A. (Cantab.), Medical College, Colombo, Ceylon
1890		Brownsword, Frank, M.Sc. (Vict.), F.I.C., Bryn Derwen, Old Colwyn, N. Wales
1902		Bruce, Alexander, B.Sc., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1894	Trans.	Bruce, James, B.Sc. (Lond.), A.R.C.S., F.I.C., The Technical College, Huddersfield
1901		‖Bruce-Kingsmill, Julian, Major, R.A., M.A., and B.Sc. (Glas.), c/o Messrs. E. S. Hindley & Sons, Engineers, Bourton, Dorset
1895		Bruckmann, Gustav Theodore, B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1903		Brühl, Paul, Civil Engineering College, Sibpur, near Calcutta, India
1899	Trans.	‖Brünnich, Johannes Christian, F.I.C., Department of Agriculture, Brisbane, Queensland
1893	Trans.	‖Brunton, John Dixon, c/o Prof. O. W. Richardson, Princeton, N.J., U.S.A.
1902		Bryant, Vernon Seymour, B.A. (Cantab.), 80, Beeches-road, West Bromwich
1877	Trans.	‖Buch, Carl von, M.A. (Oxon.), F.I.C., 36, Great Marylebone-street, W.
1877	Trans.	Buchanan, John Young, M.A. (Cantab.), F.R.S., F.I.C., 26, Norfolk-street, Park-lane, W.
1876		‖Buckmaster, Charles Alexander, M.A. (Oxon.), F.I.C., 16, Heathfield-road, Mill Hill Park, Acton, W.
1902		Bucknell, Edwin Thomas Holman, 19, Reservoir-road, Edgbaston, Birmingham
1903		Buggé, Erasmus Robert, 296, Burdett-road, Stepney, E.
1898	Trans.	Bull, Benjamin Samuel, M.A., B.Sc. (Ch. Ch. N.Z.), Ph.D. (Munich), F.I.C., Greylands, 104, Humber-road, Blackheath, S.E.
1901		Bult, Herbert John, 18, Billiter-street, E.C.
1890		Bunting, Henry Herbert, Oficina de Ensayes F. C. C. del Peru, Callao, Peru
1896		Burbridge, James Kerry, F.I.C., The Orchard, Philip-lane, Tottenham, N.
1891		Burford, Samuel Francis, Beechworth, Stoneygate-road, Leicester
1894	Trans.	Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.

Date of Election.		
1901		Burgess, Percival James, M.A. (Cantab.), Government Analyst, Singapore, Straits Settlements
1884		Burgess, William Thomas, F.I.C., 20, Priory-road, Bedford Park, W.
1903		Burghard, William Godsell, 180, High Holborn, W.C.
1884		‖Burland, Jeffrey Hale, 342, Sherbrooke-street, West Montreal, Canada
1897		Burland, Richard Oxley, J.P., Poolstock House, Wigan
1901		‖Burnett, Theodore Ridley, B.Sc. (Vict.), Ph.D. (Bâle), The Grammar School, Kirkby Lonsdale, Westmoreland
1893		Burnham, John Charles, B.Sc. (Vict.), F.I.C., Cordite Factory, Wellington, Nilgiri Hills, India
1882	Trans.	Burrell, Benjamin Arthur, F.I.C., 8, Springfield Mount, Leeds
1902	Trans.	Burrows, Harry, Ph.D. (Heidelberg), A.R.C.S., F.I.C., The Green, Southgate, N.
1901	Trans.	Burrows, Merrick William, M.Sc. (Vict.), Dunkirk, Devizes
1905	Trans.	Burt, Bryce Chudleigh, B.Sc. (Lond.), Government Laboratory, Port of Spain, Trinidad, West Indies
1891		Burton, William, Clifton Junction, near Manchester
1901		Burton, William, B.A. (Cantab.), B.Sc. (Wales), 47, Humberstone road, Cambridge
1903		Bury, Ernest, M.Sc. (Vict.), Brackley Coke Works, Little Hulton, near Bolton, Lancs.
1894		Bush, William, School of Science and Art, Free Library, Newport, Mon.
1904		Busher, Thomas Story, B.A. (Oxon.), Park Villa, Kendal
1890		Butcher, William James, B.Sc. (Lond.), Queen Elizabeth Grammar School, Ashbourne, Derbyshire
1895		Butler, David Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston, Birmingham
1894		Buttemer, Robert William, St. Mary's, Godalming, Surrey
1875		Butterfield, John Cope, F.I.C., 79, Endlesham-road, Balham, S.W.
1892		Butterfield, William John Atkinson, M.A. (Oxon.), F.I.C., 66, Victoria-street, S.W.
1902		Buxy, Tarit Kanti, Prof., Govt. College, Jubbulpore, C.P., India
1888		Byrn, George Alexander, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1906		Byrom, Thomas Henry, The Laboratory, Wigan Coal and Iron Co., Ltd., Wigan
1903		Bywaters, Hubert William, Ph.D. (Würzburg), A.R.C.S., F.I.C., 11, Kingly-street, W.
1903		Cadman, William Henry, B.Sc. (Wales), Ministry of Education, Cairo, Egypt

Date of Election.		
1893		‖Cahill, Robert Saunderson, Sunnyside, Heckmondwike
1894	Trans.	‖Cain, John Cannell, D.Sc. (Vict. and Tübingen), 28, Pembury-road, Clapton, N.E.
1906		Calam, Harold, M.Sc. (Leeds), B.Sc. (Vict.), A.I.C., 71, Cemetery-road, Beeston-hill, Leeds
1904		Caldecott, Lawrence, 56, Stanley-street, Fairfield, Liverpool
1898	Proc.	Caldecott, William Arthur, B.A. (Cape of Good Hope), Box 67, Johannesburg, S. Africa
1891		‖Calder, William Alexander Skeen, Ormidale, Little Moor Hill, Smethwick, near Birmingham
1907		Caldwell, Kenneth Somerville, B.Sc. (Wales), Ph.D. (Leipzig), Chemical Laboratory, St. Bartholomew's Hospital, E.C.
1904	Trans.	Caldwell, Robert John, B.Sc. (Lond.), 40, Salehurst-road, Crofton Park, S.E.
1906	Trans.	Caldwell, William, M.A. (R.U.I.), Physiological Department, Trinity College, Dublin
1884		Caley, Edward James, Chapel Field Works, Norwich
1903	Trans.	Calvert, Harry Thornton, Ph.D. (Leipzig), M.Sc. (Leeds), B.Sc. (Vict.), F.I.C., West Riding of Yorkshire Rivers Board, Wakefield, Yorks.
1900		Calvert, Sidney, A.M. (Harvard), B.Sc. (McGill Univ.), State University, Columbia, Miss., U.S.A.
1894		Cameron, Alexander, Whitcher-place, Rochester-road, Camden Town, N.W.
1907	Trans.	Cameron, Alexander Thomas, M.A. and B.Sc. (Edin.), Chemical Laboratory, University College, Gower-street, W.C.
1893		Cameron, James, Ingleby, 70, Old Chester-road, Wood Hey, Rock Ferry, Birkenhead
1875		Cameron, John Macdonald, F.I.C., Castle Hill, Tain, N.B.
1892		Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burma
1905		Campbell, Eric William, 49, Brougham Street, Greenock, N.B.
1905		Campbell, James Haig, Argyle, Carfin-road, Motherwell, N.B.
1903		Campbell, Thomas, 38, Eastbourne-street, Liverpool
1898		Campion, Alfred, F.I.C., 144, Wellington-street, Glasgow
1896		Candy, Hugh Charles Herbert, B.A., B.Sc. (Lond.), F.I.C., The College, London Hospital, E.
1884		Cannon, Matthew, 25, Stormont-road, Clapham Common, S.W.
1898		Cannon, Matthew James, 16 and 17, Devonshire-square, Bishopsgate-street, E.C.
1900		Cantin, Angélo, Prof., Royal College of Mauritius, Vacoas, Mauritius
1888		Carey, Alfred Edward, M.Inst.C.E., 3, Victoria-street, S.W.
1892	Trans.	Carey, Arthur, B.Sc. (Vict.), 1, Grassendale-road, Grassendale, near Liverpool

Date of Election.			
1906			Carmichael, John, 10, Cortayne-road, Fulham, S.W.
1902			Carmichael, Thomas Burnell, Parton, Whitehaven
1889			Carmody, Patrick, Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.		‖Carpenter, Henry Cort Harold, Prof., M.A. (Oxon.), Ph.D. (Leipzig), The University, Manchester; and 11, Oak-road, Withington, Manchester
1906			Carpenter, Percy Henry, A.I.C., 46, Streathbourne-road, Upper Tooting, S.W.
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895	Trans.		Carr, Francis Howard, F.I.C., Kelvin, Church-avenue, Sidcup, S.O., Kent
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks.
1902			Carrodus, Fred, Glen Fern Tower, Lansdowne-road, Wimbledon, S.W.
1882			‖Carruthers, Robert, Kirkbank House, Dumfries
1893			Carswell, Thomas Retson, 50, Sandmere-road, Clapham, S.W.
1907			Cart, John Trevor, B.Sc. (Lond.), A.I.C., 4, Simonside-terrace, Heaton, Newcastle-on-Tyne
1864		C. 1878-82, 84-8	‖Carteighe, Michael, F.I.C., Oriel, Goring, Reading
1901	Trans.		Carter, William, Sewage Works, Bury
1867			‖Carulla, Facundo Joaquin Ramon, Argyll-terrace, 84, Rose-hill-street, Derby
1895			Case, Thomas Bennett, B.A. (Oxon.), 108, James's-street, Dublin
1879			‖Cassal, Charles Edward, Col., V.D., F.I.C., Town Hall, Kensington, W.
1903			Castell-Evans, John, F.I.C., Carn Dochan, 4, Ranelagh-gardens, Ilford, E.
1894			Catherall, Ezra, A.R.C.S., Heathmere, Albany-road, Harborne, Birmingham
1903			‖Caudwell, Ben, B.A. (Lond.), 28, Wigfull-road, Sheffield
1898	Trans.		Caven, Robert Martin, D.Sc. (Lond.), F.I.C., University College, Nottingham
1902			Challen, Matthew Bradbury, School of Mines, Daylesford, Victoria, Australia
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, Arthur Garratt, 3, Market-place, Rugby
1906			Chamberlain, Percy Garratt, M.A. (Cantab.), 3, Market-place, Rugby
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan

Date of Election.			
1883			‖Chance, Alexander Macomb, c/o Messrs. Chance and Hunt, Ltd., Chemical and Cement Works, Oldbury
1902			‖Chance, Kenneth Macomb, M.A. (Cantab.), 14, Cornwall-terrace, Regent's Park, N.W.
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1889			‖Chaplin, Edward Mitchell, Ph.D., Public Analyst's Office, Wakefield
1886	Trans.		Chapman, Alfred Chaston, F.I.C., 8, Duke-street, Aldgate, E.C.
1895			Chapman, Arthur Jenner, F.I.C., Baronsmere, Stanhope-avenue, Church-end, Finchley, N.
1899	Trans.		Chapman, David Leonard, B.A. (Oxon.), 10, Parsonage-road, Withington, Manchester
1900	Trans.		Chapman, Edgar Marsh, F.I.C., Cairnsmore, Manor-road, Scarborough
1891			Charles, Rhys Pendrill, F.I.C., Plâs Newydd, Neath
1900			Chater, Arthur Brand, 65, Queen-street, Brisbane, Queensland
1894	Trans.	C. 1900-03	Chattaway, Frederick Daniel, M.A. (Oxon.), D.Sc. (Lond.), Ph.D. (Munich), Hon. B.Sc. (Birm.), F.R.S., F.I.C., Longfield, Kenton-road, Harrow
1905			Chatterji, Hem Chandra, Prof., B.A. (Allahabad), Christ Church College, Cawnpore, India
1895			Cheadle, Walter William, M.A. (Oxon.), 36, London-road, Grays, Essex
1899			Cheater, Thomas John, B.Sc. (Lond.), 3, The Mansions, Star and Garter, Putney, S.W.
1900			Cheeseright, John Henry, B.Sc. (Lond.), 7, Claremont-place, Gateshead-on-Tyne
1887			Chenhall, James Warne, M.Inst.C.E., Dart-villas, Totnes, Devon
1882			‖Chester, Edward D., M. Inst. M. E., c/o Alfred Ewing, Esq., 36, Camomile Street, E.C.
1897	Trans.		Chikashigé, Masumi, D.Sc. (Kyoto), Viktoria Luise-platz, 4, bei Frau Koch, Berlin, Germany
1897			Cholerton, Alfred Foster, c/o Messrs. A. de St. Dalmas & Co., 40½, Belgrave-gate, Leicester
1891	Trans.		‖Chorley, John Christmas, Bewsey, Oxford-road, Birkdale, Lancs.
1907			‖Christie, John, B.A. (Cantab.), Eton College, Windsor
1874			Christopher, George, Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William James, F.I.C., 7, West George-street, Glasgow ; and Shawfield Works, Rutherglen, near Glasgow
1906			Chrystall, Edwin Rodney, B.Sc. (Lond.), Forest Villa, Prince's-road, Buckhurst Hill, Essex

Date of Election.			
1856	Trans.	C. 1876-80, 87-90	‖Church, Arthur Herbert, Prof., M.A., D.Sc. (Oxon.), F.R.S., F.I.C., Shelsley, Kew, Surrey
1903			Clacher, William, c/o Mrs. Cuthbert, 33, Kelly-street, Greenbank, Greenock, N.B.
1888	Trans.		Claisen, Ludwig, Geh. Rath Prof., Ph.D. (Bonn), Augustastrasse 24, Godesberg-am-Rheim, Germany
1901	Trans.		Clark, Ernest, B.Sc. (Lond.), Royal Technical Institute, Salford, and 16, Havelock-street, Sheffield
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1905			Clark, Friend Ebenezer, B.Sc. (Virg.), Ph.D. (Johns Hopkins Univ.), The Central University of Kentucky, Dannville, Ky., U.S.A.
1905			Clark, Thomas Walter Firth, 24, Witherington-road, Highbury, N.
1906	Trans.		Clarke, Reginald William Lane, A.I.C., 15, Torridon-road, Hither Green, S.E.
1905			Clarkson, George Douglas, King-street, Mirfield, Yorks.
1902			Claudet, Arthur Crozier, A.R.S.M., F.I.C., 6 and 7, Coleman-street, E.C.
1882	Proc.		Clayton, Edwy Godwin, F.I.C., 23, Holborn-viaduct, E.C.
1904			Clayton, Ellis, Municipal Technical Institute, Belfast
1893			Clayton, George, Northern College of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, 3 and 5, Concert-street, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A. (Oxon.), F.I.C., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, William, Sewage Outfall Works, Wolverhampton
1878			Cloud, Thomas Charles, A.R.S.M., F.I.C., Coronation House, 4, Lloyds-avenue, Fenchurch-street, E.C.
1907	Trans.		Clough, George William, B.Sc. (Birm.), 29, Oseney-crescent, N.W.
1902			Clough, William Thomas, A.R.C.S., Chelladene, St. Margaret's-road, Wanstead Park, Essex
1869	Trans.	C. 1885-90, 99-03	‖Clowes, Frank, Prof., D.Sc. (Lond.), F.I.C., The Grange, College-road, Dulwich, S.E.; and 40, Craven-street, Charing Cross, W.C.
1902			Clowes, George Henry Alexander, Ph.D. (Göttingen), Gratwick Research Laboratory, University of Buffalo, U.S.A.
1897			Clutterbuck, Medwin Caspar, B.Sc. (Lond.), Ph.D. (Strassburg), 61, Beaconsfield-villas, Brighton
1905	Trans.		Coates, Joseph Edward, B.Sc. (Wales), Sunny Side, Oakamoor, Stoke-on-Trent
1887			Coates, William Henry, M.A., M.B. (Dun.), M.R.C.S., L.R.C.P. and L.S.A. (Lond.), 7, Albion-street, Hull

Date of Election.			
1896			Cobb, Walter William, M.A. (Oxon.), Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A. (Cantab.), Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D. (Berlin), 115-119, W. 68th-street, New York City, U.S.A.
1880			‖Cockburn, Arthur Cecil, The Grange, Otley, near Ipswich
1906			Cockburn, Charles Taylor, 34, Queen's - gate, Dowanhill, Glasgow
1895	Trans.		Cockburn, George Bertram, B.A. and B.Sc. (Oxon.), The Ryelands, Taynton, Newent, Gloucester
1901			Cockburn, Thomas Kennedy, 148, Woodstock-avenue, Shawlands, Glasgow
1892			Cockerill, Thomas, Bolton, Colpetty-road, Colombo, Ceylon
1893			Cocking, Allan Thomas, Carhampton House, Four Oaks, Sutton Coldfield
1888			Cocking, Lewis Smith, Rashcliffe Dyewood Mills, Huddersfield
1902			Cockle, Charles, 44, Fairfield-road, Winchester
1901			Coddington, Eustace, M.A. (Cantab.), 131, St. James's-road, Upper Tooting, S.W.
1903			Codling, Arthur John, 5, Tavistock-square, W.C.
1881			‖Coffin, Walter Harris, The National Liberal Club, Whitehall-place, S.W.
1885	Trans.		Cohen, Julius Berend, Prof., Ph.D. (Munich), B.Sc. (Vict.), The University, Leeds
1901			‖Cohen, Robert Waley, M.A. (Cantab.), 11, Sussex-square, W.
1907			Colebourn, William Arthur, 101, Graham-road, Wealdstone, Middlesex
1891	Trans.		Colefax, Arthur, M.A. (Oxon.), Ph.D. (Strassburg), 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, F.I.C., S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Collenette, Adolphus, Brooklyn, Fort-road, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcs.
1905	Trans.		Colles, William Morris, jun., B.Sc. (Lond.), Chemical Laboratory, School of Medicine, Cairo, Egypt
1881			Collett, John Marton, Hillfield, Gloucester
1885	Trans.	C. 1889-94, 1900-1	‖Collie, John Norman, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc. (Lond.), F.I.C., 73, Fountain-road, Edgbaston, Birmingham
1892			‖Collins, Hugh Brown, B.Sc. (Glas.), Auchinbothie Estate Office, Kilmacolm, S.O., Renfrewshire, N.B.
1890			‖Collins, Sydney Hoare, M.Sc. (Dun.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne

Date of Election.			
1888			Collins, Walter Hepworth, c/o Messrs. Edward Wihl & Co., 17, Nicholas-street, Manchester
1905			Collitt, Bernard, 79, Eastbourne-terrace, Gainsborough
1887	Trans.		‖Colman, Harold Govett, Ph.D. (Würzburg), M.Sc. (Vict.), F.I.C., Elmside, Worcester Park, Surrey
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900			Comber, Albert Walter, F.I.C., c/o Messrs. Dymes & Co., Ltd., Broadway, Madras, India
1892			‖Comyns, Frank, M.A. (Oxon.), Brynm, Craven-street, Newbury, Berks.
1899			Connah, James, B.Sc. (Lond.), F.I.C., The Laboratory, Custom House, E.C.
1875			Connor, Charles Cunningham, B.A. (Q.U.I.), 4, Queen's Elms, Belfast
1883			‖Conrad, Edwin Charles, 24, Felbrigge-road, Seven Kings, Essex
1906			Conyngham, William Boulton, 12, Grafton-street, Dublin
1902			Cook, Arthur James, 167, Richmond-road, Hackney, N.E.
1875	Trans.		‖Cook, Ernest Henry, D.Sc. (Lond.), F.I.C., The Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895			Cook, Herbert William, B.Sc. (Lond.), The Technical Institute, Tunbridge Wells, Kent
1907			Cook, Taylor, B.Sc. (Lond.), A.R.C.S., 20, Studdridge-street, Parson's Green, S.W.
1890			Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888			Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889			Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.
1898			‖Cooper, Albert John Bullen, Grimston Lawn, Haven-green, Ealing, W.
1892			Cooper, Arthur James, B.A. (Dub.), B.Sc. (Lond.), F.I.C., Brewood School, Staffs.
1888			Cooper, Astley, Clifford, near Boston Spa, S.O., Yorks.
1906			Cooper, Herbert Reginald, B.Sc. (Lond.), Redington, Northwood, S.O., Middlesex
1904			Cooper, Jabez Horace, B.A. (Oxon.), 13, Victoria-terrace, Exeter
1898			Cooper, John Burdon, M.D., B.S., B.Sc. (Dun.), 22, The Circus, Bath
1900			Cooper, William Francis, B.A. (Cantab.), 7, Grosvenor-road, Watford
1891			Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897			Cooper, William Ranson, M.A., B.Sc. (R.U.I.), A.C.G.I., A.I.C., 113, Tulse Hill, S.W.

Date of Election.		
1894	Proc.	Coote, Arthur Herbert, B.Sc. (Lond.), Garwood, 36, Humber-road, Blackheath, S.E.
1899	Trans.	Cope, Frank, Swindon Villa, Dewsbury
1907		Copping, Hugh Hague, B.A. (Dub.), Cabourne Parva, Caistor, Lincs.
1890		‖Coppock, John Bridgeford, B.Sc. (Lond.), F.I.C., The Technical School, Kendal
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts.
1901	Trans.	Cormack, William, c/o Messrs. G. Nelson Dale & Co., Emscote Mills, Warwick
1888		‖Cornish, Vaughan, D.Sc. (Vict.), 157, Westbourne-grove, W.
1906		Cornwall, Reginald de Vere, Medical and Public Health Dept., Salisbury, Rhodesia, South Africa
1890		Corrie, David, Nobel's Explosives Co., West Quarter Factory, Polmont Station, N.B.
1893	Trans.	Coste, John Henry, F.I.C., 54, Alconbury-road, Upper Clapton, N.E.
1892		‖Couldrey, Henry, His Majesty's Mint, Bombay, India
1905		Coupe, Miles, 46, Millarbarn-lane, Waterfoot, near Manchester
1906	Trans.	Courtauld, Stephen Lewis, B.A. (Cantab.), Bocking-place, Braintree, Essex
1900		Courtman, Ernest Owen, Denford House, Atkins-road, Clapham Park, S.W.
1903		‖Cousins, Francis George, 16, Old Elvet, Durham
1901	Trans.	Cousins, Herbert Henry, M.A. (Oxon.), Government Laboratory Kingston, Jamaica
1885		Cousins, William James, F.I.C., 17, Temple-chambers, Temple-avenue, E.C.
1886	Trans.	‖Coutts, Francis James Henderson, M.D., B.Ch., D.P.H. (Vict.), 264, Hornby-road, Blackpool
1907		Cowap, Matthewman Dalton, 8, Sheldon-road, Cricklewood, N.W.
1906		Coward, Hubert Frank, M.Sc. (Manc.), Hulme Hall, Victoria Park, Manchester
1898		Cowburn, Arthur William, 29, Princess-street, Manchester
1882		‖Cowie, Thomas Rennie, Garnkirk House, Garnkirk, N.B.
1905		Cowie, William Beaverly, 26, East Claremont-street, Edinburgh
1898		Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873		Cownley, Alfred John, F.I.C., 225, Barry-road, Dulwich, S.E.
1905		Cowman, Douglas Henry Bellars, Heathville-corner, Gloucester
1904		Cowper, Alfred Denys, 121, Castellain-mansions, Maida Vale, W.
1888		Cowper, Joseph, 50, King-street, Penrith
1886		Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham

Date of Election.			
1898			Cox, Frederick Hudson-, F.I.C., 46, St. James'-road, Brixton, S.W.
1873			Cox, Samuel Herbert, 13, St. Helen's-place, E.C.
1904			Crabb, William, B.Sc. (Lond.), 7, Edridge-road, Croydon
1901			Crabtree, Arthur, 148, Westgate-road, Newcastle-on-Tyne
1870	Trans.		Crafts, James Mason, Prof., 59, Marlborough-street, Boston, Mass., U.S.A.
1892	Trans.		Craig, Andrew William, College of Pharmacy, 360, Swanston-street, Melbourne, Victoria
1897			Cranfield, William, The Higher Grade Board School, Halifax
1897			Creasey, Clarence Hamilton, Beechwood, Thorn-park-road, Plymouth
1887			‖Cribb, Cecil Howard, B.Sc. (Lond.), F.I.C., 136, Shaftesbury-avenue, W.
1878			‖Criper, William Risdon, A.R.S.M., F.I.C., Chemical Works, Konnagar, Calcutta
1895			Crocker, Charles, Norman House, St. Peter's-road, Cockett, Swansea
1906			Crocker, Henry Ernest, 452, Slade-road, Gravelly Hill, Birmingham
1902	Trans.		Crocker, James Codrington, M.A. (Cantab.), D.Sc. (Lond.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1901			Crocker, Walter Stevens, A.R.C.S., 39, Arnold-street, Princes Park, Liverpool
1897	Trans.		Crofts, James Murray, M.A. (Cantab.), B.Sc. (Lond.), The College, Barnato Park, Johannesburg, S. Africa
1886	Trans.		‖Crompton, Holland, Binfield, Chester-road, Northwood, S.O., Middlesex
1902			Crookes, Henry, 109, Ladbroke-grove, Notting Hill, W.
1901	Trans.		Crookes, Samuel Irwin, Marama-avenue, Owen's-road, Epsom, Auckland, New Zealand
1857	Trans.	C. 1866-70 V.P. 76-9, 85-7 P. 87-9	‖Crookes, Sir William, D.Sc. (Oxon., R.U.I., Cape of Good Hope), F.R.S., F.I.C., 7, Kensington Park-gardens, W.; and Athenæum Club, Pall Mall, S.W.
1879	Trans.	C. 1890-1, 93-5	‖Cross, Charles Frederick, B.Sc. (Lond.), F.I.C., 3, New-court, Carey-street, W.C.
1890	Trans.	C. 1901-2 S. 1905-	‖Crossley, Arthur William, Prof., D.Sc. (Vict.), Ph.D. (Würzburg), F.R.S., F.I.C., Pharmaceutical Society, 17, Bloomsbury-square, W.C.; and 10, Crediton-road, West Hampstead, N.W.
1896			Crossman, Charles Matthew, B.Sc. (Lond.), Cannon House, Watford, Herts.
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1899			Crouch, William Samuel, 265, Glossop-road, Sheffield
1880	Trans.		Crow, John Kent, D.Sc. (Lond.), F.I.C., Ivydene, Westcombe-park-road, Blackheath, S.E.

Date of Election.		
1887		‖Crowther, Horace Woodward, F.I.C., The Beeches, West Bromwich
1895		Croysdale, John, Whitley Bridge, S.O., Yorks.
1884		Crumbie, William Drake, 146, Washington-street, East Orange, N. J., U.S.A.
1887	Trans.	Cundall, James Tudor, B.Sc. (Lond.), F.I.C., Edinburgh Academy, Henderson-row ; and 1, Dean-park-crescent, Edinburgh
1904		Cunningham, James Edward, 21, Blenheim-gardens, Willesden Green, N.W.
1907		Cunningham, John Arthur, Prof., B.A. (Cantab. and R.U.I.), A.R.C.S.I., The Observatory, Alipore, Calcutta, India
1899	Trans.	Cunnington, Alfred Valentine, B.A. (Cantab.), c/o Messrs. Brunner, Mond & Co., Northwich
1875		Curphey, William Salvador, F.I.C., 7, Derby-crescent, Kelvinside, Glasgow
1900		Cussons, John, B.Sc. (Vict.), High School, Aliwal North, Cape Colony, S. Africa
1881		‖Custance, John D., Prof., Broad View, Georgetown, S. Australia
1895		Cuthbertson, Lionel Mould Gurney, 89, Lordship Park, N.
1894		Dains, Herbert Henry, F.I.C., 27 Inderwick-road, Stroud Green, N.
1901	Trans.	Dakin, Henry Drysdale, D.Sc. (Vict.), F.I.C., 819, Madison-avenue, New York, U.S.A.
1907		Dall, Colin Ernest, B.Sc. (Lond.), Maisonette, Maybury-road, Woking, Surrey
1905		Dallman, Arthur Augustine, Lyndhurst, Prospect-vale, Liverpool
1904		Dalton, William Herbert, 85, Hayter-road, Brixton Hill, S.W.
1901	Trans.	Daniel, Gilbert Howard, B.Sc. (Lond.), 25, Church-walk, Ulverston
1897		Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal, S. Africa
1887		Daniell, Louis Charles, Royal Standard Brewery, Tamworth, N.S.W.
1902		Daniels, James Ward, Westwood, Medomsley, S.O., Co. Durham
1892	Trans.	Darbishire, Francis Vernon, B.A. (Oxon.), Ph.D. (Leipzig), South Eastern Agricultural College, Wye, Kent
1852		Darby, Stephen, F.I.C., Cookham Dean, Berks.
1899		Darling, Charles Robert, A.R.C.S.I., A.I.C., Bryniach, Brent-road, Plumstead, Kent
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	‖Darling, William Howarth, F.I.C., 26, Dover-street, Manchester

Date of Election.		
1893		Davey, George, 34, Carlton-vale, Maida-vale, W.
1875		‖Davey, G. William, 2, Compton-avenue, East Ham, E.
1905		Davey, Joseph Morgan, Shelone House, Briton Ferry, Glam.
1897		Davidge, Henry Norris, 23, Rydal-road, Streatham, S.W.
1900		Davidson, Alexander, jun., F.I.C., 8, Traquair-park, Corstorphine, S.O., Midlothian
1906		Davidson, Charles, 328, Golfhill-drive, Dennistoun, Glasgow
1907		Davidson, Francis, Dover-place, Ashford, Kent
1901		Davidson, John Howard, B.Sc. (Vict.), Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell-green, Halifax
1899	Trans.	Davidson, William Brown, M.A., D.Sc. (Aberd.), Ph.D. (Würzburg), F.I.C., Saltley Gas Works, Birmingham
1866	Trans.	‖Davies, Arthur Ellson, Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, The Laboratory, 28, Chapel-street, Liverpool
1905		Davies, John Llewelyn, B.A. (Cantab.), The Perse School, Cambridge
1896		Davies, Llewellyn John, Bute-chambers, Bute-road, Cardiff
1894		Davies, Samuel Henry, B.Sc. (Vict.), Rowntree's Cocoa Works, York
1900		Davis, Arthur Charles, 2, Downing-grove, Cambridge
1902		Davis, Charles Benson, c/o Dr. Francis Wyatt, S.W.-corner, 23rd-street, and 9th-avenue, New York City, U.S.A.
1901		Davis, Francis, Forest Villa Ovenden, Halifax, Yorks.
1902		Davis, Frederick, B.Sc. (Vict.), Hazel House, Hayfield, near Stockport
1902		Davis, Henry Wilson, F.I.C., Farleigh, Crescent-road, Kingston Hill, S.W.
1857		‖Davis, J. Frederick, c/o J. Lewis, Esq., Government Laboratory, Parliament-street, Cape Town, S. Africa
1872	Trans.	‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876		‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1897	Trans.	Davis, William Alfred, B.Sc. (Lond.), Central Technical College, South Kensington, S.W.
1900		Davison, Thomas Cuthbert, Bower-hill, Exmouth-street, Swindon, Wilts.
1906		Davson, Archibald Prideaux, A.R.C.S., 118, Brownhill-road, Catford, S.E.
1895		Daw, Frederic Weldon, A.R.C.S., F.I.C., Eureka-place, Ebbw Vale, Mon.
1900	Trans.	Dawson, Harry Medforth, B.Sc. (Lond. and Leeds), Ph.D. (Giessen), The University, Leeds; and North-terrace, Bramley, Leeds

Date of Election.			
1890			Day, Charles Edwin, B.Sc. (Edin.), The Mines, Coniston, Lancs.
1881	Trans.		‖Day, Thomas Cuthbert, 36, Hillside-crescent, Edinburgh
1905			Day, William Walpole, B.Sc. (Wales), Llandilo, Attleborough-road, Nuneaton
1907			Dealy, Thomas Kirkman, Craigmin East, Magazine Gap, Hong Kong, China
1901	Trans.		Dean, George, M.A. (Cantab.), 4, Empress-avenue, Ilford, E.
1904			Deane, Harold, B.Sc. (Lond.), A.I.C., 34, Drakefield-road, Upper Tooting, S.W.
1886			Deane, Leopold Mandeville, c/o The Lancashire Explosives Co., Ltd., 2, Albert-Street, Manchester
1859		V.P. 1871-4	Debus, Heinrich, Prof., Ph.D. (Marburg), F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1899	Trans.		‖De Castro, John Paul, M.A. (Cantab.), F.I.C., 1, Arundel-street, Strand, W.C.
1885	Trans.		Dechan, Martin, F.I.C., Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, Hollydene, Tenison-avenue, Cambridge
1903			Deeks, William Thomas, High-street, Shanklin, Isle of Wight
1869	Trans.		‖Deering, William Henry, I.S.O., F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël Fielding, Experiment Station, Hawaian Sugar Planters' Association, Honolulu, H.I., U.S.A.
1902			De la Rue, Evelyn Andros, B.A. (Oxon.), 110, Bunhill-row, E.C.
1905			De Lury, Ralph Emerson, M.A. and Ph.D. (Toronto), The Dominion Astronomical Observatory, Ottawa, Canada
1907			Denham, William Smith, B.Sc. (Lond.), F.I.C., 2, Kelvinside-terrace-north, Glasgow
1892			Denison, Joseph Richard, Lingholme, Heaton, Bradford
1902			Dennis, William, High-street, Mundesley-on-Sea, S.O., Norfolk
1906			Denton, John, Horton Villa, Bradford
1903	Trans.		Desch, Cecil Henry, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Instow, Mount Pleasant-road, South Tottenham, N.
1897			Deverell, Louis Charles, Straits Trading Co., Singapore, Straits Settlements
1870	Trans.	C. 1874-7 V.P. 80-3 86-8, 96-7 P. 97-9	‖Dewar, Sir James, Prof., M.A. (Cantab.), Hon. LL.D. (St. Andrews, Aberd., Edin., Glas.), Hon. D.Sc. (Oxon., Dub., Vict., Ireland), F.R.S., F.I.C., Royal Institution, Albemarle-street, W.
1900			Dewhirst, John Arthur, F.I.C., 13, Highfield-terrace, Nab Wood, Saltaire, Bradford
1880			Dibdin, William Joseph, F.I.C., Purley Bury, Purley-downs-road, Sanderstead, Croydon
1872			‖Dickinson, Arthur John, F.I.C., Truro Villa, 57, Lewisham-high-road, S.E.

Date of Election.			
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1906			Dickson, William, 26, Clyde-street, Edinburgh
1907			Dikshit, Mohan Nath Kedarnath, Amliran, Surat, India
1906			Dinwoodie, James Herbert, 71, Bree-street, Johannesburg, S. Africa
1860	Trans.	C.1873-4 V P. 1900-03	‖Divers, Edward, Prof., M.D. and Hon. D.Sc. (R.U.I.), F.R.S., F.I.C., 3, Canning-place, Palace Gate, W.
1903			Divine, Thomas, M.D. and C.M. (Glas.), D.P.H. (Lond. and Cantab.), 30, Percy-street, Huddersfield
1897			Dixon, Andrew James, F.I.C., Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900–06	Dixon, Augustus Edward, Prof., M.D. (Dub.), Queen's College; and Fernhurst-avenue, Western-road, Cork
1896	Trans.		Dixon, Frank, B.Sc. (Lond.), The Institute, Lydney, Gloucester
1894	Proc.		¶‖Dixon, George, M.A. (Cantab.), Trinity College, Cambridge; and St. Bees, S.O., Cumberland
1876	Trans.	C.1892-6 V.P. 1904-7	‖Dixon, Harold Baily, Prof., M.A. (Oxon.), F.R.S., The University, Manchester
1893			Dixon, Harry William, Clarence Iron and Steel Works, Leeds
1902			Dixon, John Kemp Smith, 55, Broxholme-lane, Doncaster
1895			Dixon, William, 102, Spring-street, Bury
1862			Dixon, William Adam, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1882	Trans.	C.1901-6 V.P. 1907-	Dobbie, James Johnston, Prof., M.A. (Glas.), D.Sc. (Edin.), F.R.S., F.I.C., Museum of Science and Art, Edinburgh
1887	Trans.		Dobbin, Leonard, Ph.D. (Würzburg), F.I.C., Chemical Laboratory, New University-buildings, Edinburgh
1898			Dodd, Frederick Robertson, F.I.C., Victoria-villas, 139, Burscough-street, Ormskirk
1901			Dodd, Robert, 28, Sibella-road, Clapham, S.W.
1886			Dodd, W. Ralph, Trederwen, Village-road, Enfield, Middlesex
1892			Dodds, George Price, 14, St. Luke's-terrace, Darlington
1905			Dodds, Roger, Kingswood School, Bath
1897	Proc.		Dodgson, John Wallis, B.Sc. (Lond.), University College, Reading
1894	Proc.		Doherty, William Michael, F.I.C., Government Laboratory, Sydney, N.S.W.
1905			Donald, Robert, M.A., B.Sc. (N.Z.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Oxon.), Mental Hospital, Orokonui Home, Waitati, New Zealand
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1901	Trans.		Donnan, Frederick George, Prof., M.A. (R.U.I.), Ph.D. (Leipzig), Muspratt Laboratory, The University, Liverpool

Date of Election.		
1897	Trans.	Dootson, Frederick William, M.A. (Cantab.), D.Sc. (Dub.), F.I.C., University Chemical Laboratory, Cambridge
1902		Dorée, Charles, M.A. (Oxon.), B.Sc. (Lond.), 87, Gore-road, N.E.
1900		Dougall, James Dick, Senhouse-street, Maryport, Cumberland
1888		‖Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1905		Doull, John, 22, Lauriston-place, Edinburgh
1884		Down, Frederick Johnathan, Glengariff, Milton-road, Harpenden, Herts.
1899		Doyle, Frederick, Oakdene, Scotland-road, Stanwix, Carlisle
1899		Drake, Francis Alfred, B.Sc. (Lond.), 24, Cavendish-square, Hull
1884		Draper, Henry Carter, 68, Wodehouse-terrace, North Circular-road, Dublin
1891	Proc.	Dreaper, William Porter, F.I.C., Woodcroft, Felixstowe, S.O., Suffolk
1893		Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1906		Drinkwater, Lionel John, Burford, Oxon.
1902		Drought, James Justinian, Molo, *viâ* Mombasa, British East Africa
1895		Druce, Edric, County Agricultural Institute, Ridgmont, Aspley Guise, S.O., Beds.
1904	Trans.	Drugman, Julien, Ph.D. (Bonn), Technical School, Huddersfield
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1907		Duckworth, Samuel, M.Sc. (Vict.), 78, Alexandra-road, Lowestoft
1901		Duckworth, William Henry, Blackburn Corporation Sewage Works, Samlesbury, near Preston
1900		Dudderidge, Frank Rawlinson, 45, Sidney-grove, Newcastle-on-Tyne
1898		Dudley, Charles Benjamin, Ph.D. (Yale), Drawer 334, Altoona, Pa., U.S.A.
1890		‖Dudley, William Lofland, Prof., Vanderbilt University, Nashville, Tennessee, U.S.A.
1892		Duffield, Walter William, 5, Ashington-road, Hurlingham, Fulham, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A. (Cantab.), D.Sc. (Lond.), Laurel Bank, Claremont-road, Headingley, Leeds
1897		Dufty, Lawrence, 8, Clarke-street, Sheffield
1884		Duggan, Thomas Richard, F.I.C., 60, Foyle-road, Blackheath, S.E.
1889		Duisberg, Carl, Prof., Ph.D., Elberfeld, Germany
1889		‖Dukes, Thomas William, P.O. Box 10, Vryheid, S. Africa
1881		Duncan, Arthur William, 1, Trafalgar-road, Higher Bentcliffe, Pendleton, Manchester

Date of Election.			
1894	Proc.		‖Duncan, Cecil Cooke, F.I.C., The Shire Hall, Worcester
1906			Duncan, Robert Kennedy, Prof., University of Kansas, Lawrence, Kansas, U.S.A.
1891			Duncan, William, F.I.C., The Laboratory, 65, Bath-row, Edgbaston, Birmingham
1896			Duncan, William, Royal Dispensary, 21, West Richmond-street, Edinburgh
1905			Dunlop, Harry, Cragdarroch Cove, Dumbartonshire, N.B.
1894	Proc.		‖Dunn, Frederic, 193, Collins-street, Melbourne, Australia
1882			Dunn, John Thomas, D.Sc. (Dun.), F.I.C., 10, Dean-street, Newcastle-on-Tyne
1893			Dunnington, Francis Perry, University of Virginia, Charlottesville, U.S.A.
1899			Dunscombe, Frederick Charles, c/o Electric Reduction Co., Buckingham, Quebec, Canada
1901	Trans.		Dunstan, Albert Ernest, B.Sc. (Lond.), East Ham Technical College, East Ham, E.
1885			Dunstan, Malcolm James Rowley, M.A. (Oxon.), F.I.C., The College, Wye, Kent
1905			Dunstan, Sydney, The Royal Infirmary, Newcastle-on-Tyne
1879	Trans.	C. 1888-91 S. 93-1903 V.P. 1903-06	‖Dunstan, Wyndham Rowland, Prof., Hon. M.A. (Oxon.), Hon. LL.D. (Aberd.), F.R.S., F.I.C., Imperial Institute, S.W.
1896			Durant, Henry Thomas, The Rhodesia Gold Fields, Ltd., Bulawayo, Matabeleland, S. Africa
1871			‖Durham, Henry, 13, Coleherne-road, South Kensington, S.W.
1906			Durrans, Thomas Harold, B.Sc. (Lond.), 1, Cornwall-terrace, Regent's Park, N.W.
1883	Trans.		Durrant, Reginald Graham, M.A. (Oxon.), The College, Marlborough, Wilts.
1892			Duxbury, Thomas, 17, Grosvenor-chambers, Deansgate, Manchester
1875	Trans.	C. 1893-7 1904-	‖Dyer, Bernard, D.Sc. (Lond.), F.I.C., 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, F.I.C., Board of Education, South Kensington, S.W.
1885	Trans.		Dyson, Gibson, Ph.D., Venn Farm, Marden, Hereford
1883	Trans.		‖Dyson, Septimus, East Bank, St. Mary's-walk, Harrogate.
1905			Eade, Samuel George, 10, Eagle-street, Port Talbot, South Wales
1876			‖Earp, Francis Salsbury, Ph.D. (Giessen), F.I.C., 72, Addis-street, Kalgoorlie, W. Australia
1907			Eastaugh, Frederick Alldis, A.R.S.M., The University, Sydney, N.S.W.

Date of Election.		
1889	Trans.	‖Easterfield, Thomas Hill, Prof., M.A. (Cantab.), Ph.D. (Würzburg), F.I.C., Victoria University College, Wellington, New Zealand
1891		Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
1881		Eastick, John Joseph, A.R.S.M., F.I.C., 2, St. Dunstan's-hill, E.C.
1903		Eastwood, Arthur William, B.A. (Cantab.), Newton College, Newton Abbot, South Devon
1906		Eaton, Bertie James, A.I.C., Institute of Medical Research, Kuala Lumpur, Selangor, Federated Malay States
1878	Trans.	‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1906		Edgell, Cecil Wyatt-, B.A. (Oxon.), Cowrey-place, Exeter
1903		Edgerton, John Percy, The Laboratory, 61, Cornhill, E.C.
1902		Edlin, Edgar Leeder, B.A. (Oxon.), 31, All Saints-road, Leicester
1902		Edminson, Sidney Robert, B.Sc. (Lond.), Maritzburg College, Natal, S. Africa
1893		Edwards, Thomas, Ty Mawr, Rhymney, viâ Cardiff
1884		Edwards, Vincent, F.I.C., c/o Lawes' Chemical Manure Co., Barking Creek, Essex
1892		Edwards, Walter Nicholas, 6, Shardcroft-avenue, Herne Hill, S.E.
1898		‖Edwards, Wilbraham Tollemache Arthur, M.R.A.C., F.I.C., The Laboratory, Phœnix, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rheim, Germany
1899		Eichenauer, William Frederick, 18, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, F.I.C., 143, New Bond-street, W.
1883		‖Ekins, Arthur Edward, J.P., F.I.C., Rushden, Lattimore-road, St. Albans
1903		Elford, Archibald Sefton, M.A. (Oxon.), 41, Broomfield-road, Chelmsford
1891		Elford, Percy, M.A. (Oxon.), St. John's College, Oxford
1907		Elias, Owen Aubrey, 123, Waller-road, New Cross, S.E.
1878	Trans.	‖Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, Walter John, M.A. (Cantab.), Woodcroft, Lichfield-road, Stafford
1893		Ellis, Charles Sordes, F.I.C., Meadowlead, Station-road, Harrow
1900		Ellis, Frederic Richard, 24, Orley-Hill, Bristol
1903		Ellis, Henry Russel, 177, Warwick-road, Kensington, W.

Date of Election.		
1878		Ellis, William Hodgson, Prof., M.A. (Cantab.), M.B. (Toronto), F.I.C., School of Practical Science, Toronto, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1893		Elmore, Alexander Stanley, 4, Broad-street-place, E.C.
1902		Elsden, Alfred Vincent, B.Sc. (Lond.), F.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E.
1885		Embrey, George, F.I.C., County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton, The Copse, Hamble, Southampton
1901		English, Robert, Christchurch Gas Co., Christchurch, New Zealand
1892		Entwistle, Herbert, 1, Albert-place, Dickenson-road, Longsight, Manchester
1899		Epps, James Washington, 95, Upper Tulse Hill, S.W.
1889		Erskine, James Kerr, New Kleinfontein Co., Ltd., Post Office, Benoni, Transvaal, S. Africa
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862		‖Esson, William, Prof., M.A. (Oxon.), F.R.S., Merton College, Oxford
1865		‖Estcourt, Charles, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1899		Estcourt, Harry Estcourt, 467, West-street, Durban, Natal, S. Africa
1888		‖Estcourt, Philip Anderson, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1894		Eumorfopoulos, Nicholas, B.Sc. (Lond.), 33, Gloucester-square, Hyde Park, W.
1895		Eutroppe, Arthur Theophilus, Fort Keogh, Montana, U.S.A.
1905		Evans, Bernard Scott, B.Sc. (Lond.), 42, Keymer-road, Streatham, S.W.
1904		Evans, Edward, The Laboratory, South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1891		Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope, S. Africa
1906		Evans, Frederick Watkins, 11, High-street, Cardigan
1876		Evans, Sir John, K.C.B., D.C.L. (Oxon. and Toronto), LL.D. (Dub. and Toronto), Sc.D. (Cantab.), F.R.S., Britwell, Berkhamsted, Herts.
1904		Evans, John, F.I.C., 67, Surrey-street, Sheffield
1904		Evans, Nevil Norton, McGill University, Montreal, Canada
1892	Trans.	‖Evans, Robert Cecil Turle, 280, Philip-lane, West Green, Tottenham, N.
1888		‖Everard, Arthur George, 4, St. George's-road, Barnstaple

Date of Election.			
1902			Everitt, Walter, 83, The Grove, Ealing, W.
1894			Evershed, Frank, Kenley, Surrey
1896	Trans.		Ewan, Thomas, M.Sc. (Vict.), Ph.D. (Munich), c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1902	Trans.		Eynon, Lewis, B.Sc. (Lond.), F.I.C., 57, Darenth-road, Stamford Hill, N.
1901	Trans.		Eyre, John Vargas, Ph.D. (Leipzig), 26, Bridge-road-west, Battersea Park, S.W.
1888			Faber, Harald Nicolai, 7 and 8, Idol-lane, E.C.
1904			Fagan, Thomas Wallace, M.A. (Cantab.), Talysarn, Penygroes, S.O., Carnarvonshire
1903			Fairhall, Edwin Jesse, A.C.G.I., A.I.C., 8, Scarborough-road, Stroud Green, N.
1865	Trans.		‖Fairley, Thomas, F.I.C., 17, East-parade, Leeds
1895			Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899			Fairweather, Ernest Barratt, King's College Hospital, Lincoln's Inn Fields, W.C.
1888			Farlie, John Burke, 54, Wellington-road, Old Charlton, Kent
1906			Farmer, Charles George Edgar, 16, Herbert-crescent, S.W.
1907			Farmer, John Edwin, Blelsoe, New-road, Mitcham Junction, Surrey
1903	Trans.		Farmer, Robert Crosbie, D.Sc. (Vict.), Ph.D. (Würzburg), Somerset Villa, High-road, Mottingham, Kent
1895			Farr, Edward Henry, Uckfield, Sussex
1870			‖Farries, Thomas, F I.C., 16, Coleman-street, E.C.
1880			‖Farrington, Thomas, M.A. (Q.U.I.), F.I.C., 5, Summerhill-terrace, Wellington-road, Cork
1902			Fasnacht, Eugène Arthur, The Hollies, Clayton Bridge, Manchester
1887			Fawsitt, Charles Albert, 9, Foremount-terrace, Dowanhill, Glasgow
1903	Trans.		Fawsitt, Charles Edward, D.Sc. (Edin.), Ph.D. (Leipzig), Chemical Department, The University, Glasgow
1906	Proc.		Feilmann, Martin Ernest, B.Sc. (Lond.), Ph.D. (Bâle), F.I.C., 92, Victoria-street, S.W.
1897			Fenby, Alarick Vincent Colpoys, B.Sc. (Lond.), Hutton Grammar School, near Preston, Lancs.
1878	Trans.	C. 1898-1902	‖Fenton, Henry John Horstman, M.A., Sc.D. (Cantab.), F.R.S., F.I.C., Christ's College; and 19, Brookside, Cambridge
1898			Fergnson, James Edward, Laboratory and Assay Office, 2, Union-court, Old Broad-street, E.C.
1872		C. 1889-93	‖Ferguson, John, Prof., M.A. (Glas.), LL.D. (St. Andrews), F.I.C., The University, Glasgow
1901			Ferguson, Reginald Williams, B.Sc. (Lond.), A.R.C.S., Municipal Technical School, The Gamble Institute, St. Helens

Date of Election.			
1899			Fermor, Herbert Frederick Francis Burdett, 15, Ansdell-road, Peckham, S.E.
1902			Ferrand, Frederick, 13, Torrington-street, Hopwood, Heywood
1882			Ferrier, James, P.O. Box 764, Rome, Georgia, U.S.A.
1905			Ferrier, John Greig, 6, Brunswick-square, Port of Spain, Trinidad, West Indies
1902			Ferrier, John Oliver, 8, Spottiswoode-street, Edinburgh
1902			Ferris, Percy James, Willowmore, New-road, Lymm, Cheshire
1906			Field, Samuel, A.R.C.S., 64, Lanercost-road, Tulse Hill, S.W.
1904			Field, William Eddington, 65, Sutherland-road, Armadale, Melbourne, Australia
1895			Fielding, Patrick Joseph Dominick, 66, Patrick-street, Cork
1906	Trans.		Fierz, Hans Eduard, Ph.D. (Zürich), Royal College of Science, South Kensington, S.W.
1900	Trans.		Findlay, Alexander, M.A., D.Sc. (Aberd.), Ph.D. (Leipzig), The University, Birmingham
1905			Findon, Frank Standish, Rev., M.A. and B.Sc. (St. Andrews), 41, Great Percy-street, Holford-square, W.C.
1904			Finlow, Robert Steel, B.Sc. (Wales), c/o Messrs. Grindlay and Co., Calcutta, India
1905	Trans.		Finnemore, Horace, B.Sc. (Lond.), F.I.C., High Leasow, Coulsdon, S.O., Surrey
1907			Fischer, Eugen, Ph.D. (Zürich), c/o Messrs. Kalle & Co., Aktiengesellschaft, Biebrich-am-Rheim, Germany
1896			Fisher, Ernest Hunter, The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A. (Oxon.), F.I.C., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Sir Frederick William, Bart., M.A. (Oxon.), 64, Pont-street, S.W.
1906			Fitzgerald, Anthony Nisbet, B.A. and B.Sc. (Lond.), 12, St. Mary's-road, Strood, Kent
1900			FitzGibbon, Thomas, 115, Harbord-street, Fulham, S.W.
1896			Fleet, John Thomas, 24, Sheep-street, Rugby
1899	Trans.		‖Fleischmann, Friederich Noël Ashcroft, M.A. (Oxon.), 4, Orme-court, W.
1898			‖Fleming, John Arnold, Britannia Pottery, 136, Glebe-street, Glasgow
1903			Fletcher, Alan, 114, Beaufort-street, South Kensington, S.W.
1874			Fletcher, Frederick William, North London Chemical Works, Holloway, N.; and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A. (Oxon.), F.R.S., Natural History Department, British Museum, Cromwell-road, S.W.; and 35, Woodville-gardens, Ealing, W.

Date of Election.			
1894			‖Flintoff, Robert John, Gale Print Works, Littleborough, Lancs.
1892			Floris, Robert Brooke, F.I.C., Church House, West Hanningfield, near Chelmsford
1906	Proc.		Flurscheim, Bernhard, Ph.D. (Heidelberg), Heatherlands, Fleet, Hants.
1894			Fogg, Charles Albert, Graythorne, Albert-road, Bolton
1859			Fogg, Thomas, 93, Portsdown-road, Maida Vale, W.
1889			Foggie, John, University College, Dundee
1902			Foll, Edgar, The Cottage, The Lion Brewery, Belvedere-road, Lambeth, S.E.
1885			Follows, Harold, 4, Kensington-avenue, Victoria-park, Manchester
1894			‖Forbes, Donald Gordon, Room 35, Board of Trade Building, Victoria, British Columbia
1874			Forbes, James, jun., 70, Gracechurch-street, E.C.
1889	Trans.		Ford, John Simpson, c/o Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton, Surrey
1904			Forrest, John Kerr, Hawsleigh, Balaclava-road, St. Kilda, Victoria, N.S.W.
1893			Forrester, Alexander Machattie, c/o Messrs. Laidlaw, MacKill and Co., Ltd., 3400, Williamsburg-avenue, Richmond, Va., U.S.A.
1905			Forster, Ernest Lyle Carman, M.A. (Toronto), Chemical Department, The University, Toronto, Canada
1892	Trans.	(C. 1901-04. S. 1904-)	‖Forster, Martin Onslow, D.Sc. (Lond.), Ph.D. (Würzburg), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.
1903			Forster, William, 30, Church-street, Seaham Harbour
1856	Trans.	(C. 1865-8, 72-5, 85-6. V.P. 88-92.)	‖Foster, George Carey, Prof., B.A. (Lond.), LL.D. (Glas.), D.Sc. (Vict.), F.R.S., Emeritus Professor of Physics, University College, Gower-street, W.C.; and Ladywalk, Rickmansworth, Herts.
1872			Foster, Reginald Le Neve, Bollindene, Wilmslow, Cheshire
1906			Foucar, James Louis, B.Sc. (Lond.), 20, St. John's-park, Blackheath, S.E.
1900			Foulds, James, A.R.C.S., 7, Pearson-street, Darwen, Lancs.
1898			Foulerton, Alexander Grant Russell, F.R.C.S. (Eng.), L.R.C.P., (Lond.), D.P.H. (Cantab.), Haywards Heath, Sussex
1891	Trans.		‖Fowler, Gilbert John, D.Sc. (Vict.), F.I.C., Broad Oak, Urmston, Manchester
1900			Fowler, Morris Broad, 19, Westbury-road, Westbury-on-Trym, near Bristol
1882			‖Fowler, William, 1, Grace-terrace, Sunderland

Date of Election.			
1907			Fowles, George, 28, Weltje-road, Hammersmith, W.
1895			Fox, Albert Stanley, Rosehurst, Athelstan-road, Faversham
1907	Trans.		Fox, John Jacob, 6, Alkham-road, Stamford Hill, N.
1907			Foxell, Edward William Lanchester, B.Sc. (Lond.), Barnes, Christ's Hospital, West Horsham, Sussex
1906			Foye, Peter Bertram, 16, Burlington-road, Dublin
1879			Francis, Edward, Ivy Bank, Park-ravine, Nottingham
1902	Trans.		Francis, Francis Ernest, Prof., Ph.D. (Erlangen), D.Sc. (Vict.), F.I.C., University College, Bristol
1873			‖Francis, George Bult, 38, Southwark-street, S.E.
1881			Frankland, Henry, F.I.C., Streonshalh, The Crescent, Linthorpe, Middlesbro'.
1880	Trans.	C. 1887-9 V.P. 1902-05.	‖Frankland, Percy Faraday, Prof., Hon. LL.D. (St. Andrews), Ph.D. (Würzburg), Hon. M.Sc. (Birm.), B.Sc. (Lond.), A.R.S.M., F.R.S., F.I.C., The University, Birmingham
1867			‖Fraser, Angus, M.A., LL.D. (Aberd.), M.D., C.M. (Aberd. and Paris), 232, Union-street, Aberdeen
1892			‖Fraser, James Christopher, Mercantile-chambers, Victoria-square, Adelaide, S. Australia
1885			Freear, Harry Marshall, Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick William, Heatherdale, Spenser-road, Harpenden, Herts.
1900			Freeman, Willie Ludford, M.A. (Oxon.), 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph Thomas, Limehurst, Plymyard-avenue, Bromboro', Cheshire
1892	Proc.		French, William, M.A. (Cantab.), F.I.C., Storey Institute, Lancaster
1903	Trans.		Friend, John Albert Newton, M.Sc. (Birm.), Leistenstrasse 6/II, Würzburg, Germany
1871	Trans.	C. 1884-9, 92-6	‖Friswell, Richard John, F.I.C., Fairfield, Bexley, Kent
1890			‖Frost, Robert, B.Sc. (Lond. and Vict.), 55, Kensington-court, Kensington, W.
1904			‖Fry, George, Carlin Brae, Berwick-on-Tweed
1899			Fry, George Cecil, M.Sc. (Leeds), F.I.C., 71, George-street, Saltaire, Shipley, Yorks.
1899	Trans.		Frye, Colin Charlwood, 11, King's-avenue, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A. and Ph.D. (Leipzig), F.I.C., 13, Eaton-crescent, Clifton, Bristol
1907			Fryer, Percival John, 27, Minster-road, Cricklewood, N.W.
1891			Fulcher, Lionel William, B.Sc. (Lond.), Victoria and Albert Museum, S.W.; and Ingleside, 37, Kempshott-road, Streatham Common, S.W.
1896			Fuller, Charles James Pemeller, 603, Chorley-new-road, Horwich, near Bolton, Lancs.

Date of Election.		
1886		Fuller, John, Rookwood, 24, Mount-park-crescent, Ealing, W.
1894		‖Gabb, George Hugh, 83, Crayford-road, Tufnell-park, N.
1899		Gabriel, Edmund Vivian, M.A. (Cantab.), C.V.O., United Service Club, Simla, India
1901		Gadd, Henry Wippell, 27, East Southernhey, Exeter
1901		Gajjar, Tribhuvandas Kalyandas, Prof., M.A. and B.Sc. (Bombay), Gingaum, Bombay, India
1905		Gall, John Beaconsfield, A.C.G.I., F.I.C., 7, Linden-grove, Nunhead, S.E.
1876		Gamble, Sir Josias Christopher, Bart., Haresfinch, St. Helens, Lancs.
1903		Gandy, William Hunter, Bradley Court, Mitcheldean, Gloucester
1883	Proc.	‖Garbutt, Llewellyn, M.A. (Cantab,), The College, Winchester
1903		Gardiner, Ernest Alexander, B.A. (Oxon.), The College, Plymouth
1888		Gardiner, James Henry, 59, Wroughton-road, Balham, S.W.
1905		Gardner, Charles Richard, Chemical Laboratory, Gathurst, near Wigan
1906		Gardner, Edward, 70, Parliament-hill-mansions, Highgate-road, N.W.
1901		Gardner, Hermann Charles Thomas, Miller Hospital and Royal Kent Dispensary, Greenwich-road, S.E.
1893	Trans.	Gardner, John Addyman, M.A. (Oxon.), F.I.C., Chemical Department, St. George's Hospital, S.W.
1888		Gardner, Walter Myers, Prof., M.Sc. (Leeds), Technical College, Bradford ; and 3, Fairmount, Manningham, Bradford
1902		Garle, John Longsdon, F.I.C., 136, Holland-road, Kensington, W.
1893	Trans.	Garnett, Henry, 48, Deansgate, Manchester
1889	Trans.	Garrett, Frederic Charles, M.Sc. (Vict.), Armstrong College of Science, Newcastle-on-Tyne
1898		Garside, Arthur Leonard Harry, 6, Cotswold-terrace, Lower Broughton-road, Manchester
1906		Garvey, Richard Godfrey Hamilton, 22, Deauville-road, Clapham Common, S.W.
1884		Gaskell, Joseph, 71, Haworth's-buildings, Cross-street, Manchester
1900		Gasson, William, Dutoitspan-road, Kimberley, S. Africa
1903		Gatehouse, Frank Brooks, The Analytical Laboratory, Broad-street, Bath
1904	Trans.	Gawler, Robert, M.Sc. (Vict.), 3, South View-terrace, Bennett-road, Headingley, Leeds
1887		Geisler, Joseph Frank, Mercantile Exchange Buildings, Hudson and Harrison-streets, New York City, U.S.A.
1885		Gemmell, George Harrison, F.I.C., 4, Lindsay-place, Edinburgh

Date of Election.		
1903		Gent, Percy William, 789, Highland-avenue, Forest Hill, Newark, New Jersey, U.S.A.
1879		‖Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Director of Technical Instruction, Auckland, New Zealand
1904		Gerard, Thomas Alfred, 122, Foxhall-road, Nottingham
1889		‖Gerland, Conrad, M.Sc. (Vict.), Ph.D. (Marburg), Meadow Bank, Accrington
1891		German, George, jun., Mansion House, Ashby-de-la-Zouch
1895		‖Gerrans, Henry Tresawna, M.A. (Oxon.), 20, St. John-street, Oxford
1875		Gerrard, Alfred William, 35, Queen's-road, Wimbledon, S.W.
1899		Getman, Frederick Hutton, 811, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Lieut.-Col. I.M.S., M.B. (Aberd.), F.I.C., Chemical Examiner, Medical College, Madras, India
1904		Ghose, Anukul, 42, Shambazar-street, Calcutta, India
1890		‖Gibbes, Cuthbert Chapman, M.D. and C.M., (Aberd.), M.R.C.P. (Lond.), D.P.H. (Cantab.), 89, Harley-street, W.
1900		Gibbings, George William, Standard Bank of South Africa, Salisbury, Rhodesia, S. Africa
1897		Gibbons, Joseph Lake, Secondary School, Blyth, Northumberland
1906		Gibbs, Reginald William Malyon, B.A. (Cantab.), B.Sc. (Lond.), The Grammar School, Spilsby, Lincs.
1907		Gibson, Charles Stanley, B.A. (Oxon.), 45, Shakspeare-street, Manchester
1900		Gibson, John, St. Oswald's road, Hexham
1892	Trans.	Gibson, John, Prof., Ph.D. (Heidelberg), F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1907		Gibson, William Howieson, B.Sc. (Lond.), 48, Lady Margaret-road, Kentish Town, N.W.
1888		Gibson, William Humphrey, 122, King's-road, Brighton
1898		Gidden, William Thomas, The Hawthorns, Moat-road, Langley, near Birmingham
1895		Gilbard, John Francis Hutchins, F.I.C., 245, Dalston-lane, Hackney, N.E.
1904		Gilchrist, James Gray, M.A. (Aberd.), B.Sc. (Lond.), Newseat, Rothienorman, Aberdeenshire
1898		Gilderdale, Frederick, 32, Treherne-road, High West Jesmond, Newcastle-on-Tyne
1883		‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants.
1888		Gill, John, Gwealhellis, Helston, Cornwall
1902		Gill, J. Arthur, Pennsylvania, Lower-green-road, Rusthall, Tunbridge Wells

Date of Election.		
1898	Proc.	Gilles, William Setten, A.C.G.I., F.I.C., The Cottage, Bocking, Braintree, Essex
1905		Gillies, Albert, Government Laboratories, Johannesburg, S. Africa
1901		Gillman, Edward, Government Laboratory, Barbados, West Indies
1885		Girdwood, Gilbert Prout, M. D. and C. M. (McGill Univ.), M.R.C.S. (Eng.), F.I.C., 111, University-street, Montreal, Canada
1897		Girtin, Thomas, M.A. (Cantab.), c/o H. L. Raphael's Refinery, Thomas-street, Burdett-road, Limehouse, E.
1898		Glaister, John, Prof., M.D. (Glas.), M.R.C.S. and L.R.C.P. (Edin.), 18, Woodside-place, Glasgow
1905		Glass, Archibald Melville, B.Sc. (Lond.), 37, Chancery-lane, W.C.
1907		Gledhill, Walter George, M.A. (Cantab.), The School House, Woodbridge
1872		‖Glover, George Thomas, F.I.C., 24, Craven-hill-gardens, Lancaster Gate, W.
1904		Glover, Harry James, Mount Pleasant, Wrattle-road, Westham near Hastings
1906	Trans.	Glover, Walter Hamis, Ph.D. (Leipzig), 38, Ribblesdale-road Streatham Park, S.W.
1907		Godden, William, B.Sc. (Lond.), A.R.C.S., A.I.C., Station-road east, Canterbury
1895		Goldfinch, George, 7, Church-walk, Hendon, N.W.
1899		Golding, John, F.I.C., Midland Agricultural and Dairy Institute Kingston, Derby
1878		‖Goldschmidt, S. A., Ph.D., c/o Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, N.Y., U.S.A.
1889		Goldsmith, Byron B., Ph.B. (Columbia), 19, East 74th-street, New York City, U.S.A.
1898		Goldsmith, John Naish, B.Sc. (Vict.), Ph.D. (Heidelberg), British Xylonite Co., Manningtree, Essex
1899		Goltz, Harold Francis Carl, 155, Brixton Hill, S.W.
1897		Gomess, Alfred Francis Bilderbeck, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 33, Drayton-gardens, South Kensington, S.W.
1904		‖Goodson, John Augustus, A.I.C., Gordon College, Khartoum, Egypt
1890		Goodwin, Thomas Small, Prof., M.B. and C.M. (Glas.), F.R.S.E., 1, Heron-terrace, St. Margarets, Twickenham
1896	Trans.	Goodwin, William, B.Sc. (Manc.), Ph.D. (Göttingen), Thorncliffe, Sutton, Macclesfield
1890		Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1875		Gordon, Joseph Gordon, F.I.C., Queen Anne's-mansions, Westminster, S.W.
1905		Gorman, Henry Isaac, 126, Quay, Waterford, Ireland

Date of Election.			
1890			Gossling, Frank, B.Sc. (Lond.), H.M. Patent Office, Staple Inn, W.C.
1889	Trans.		‖Gott, Benjamin Scaife, M.A. (Cantab.), The Guildhall, Westminster, S.W.
1903			Gough, Henry, 188, Weaste-lane, Pendleton, Manchester
1900			Gough, John Henry, 65, Grange-avenue, Chapeltown-road, Leeds
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, D.Sc. (Lond.), F.I.C., 88, Sylvan-avenue, Chitts Hill, N.
1887			Gover, Herbert James, 29, Piccadilly, Hanley, Staffs.
1889			Gow, Robert John, Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, Ashleigh, Furness Park-road, Barrow
1871	Trans.	C. 1898-01, 1906-7	‖Gowland, William, Prof., A.R.S.M., F.I.C., 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George Arthur, Hawkins-road, Medindie, Adelaide, S. Australia
1884			Grace, William Frank, 54, York-road, Hove, Sussex
1862		C. 1880-1	‖Graham, Charles, Prof., D.Sc. (Lond.), F.I.C., The Reculvers, Hastings
1880	Trans.		‖Graham, Christopher Colborne, F.I.C., Oriel House, Scarborough
1890	Trans.		Grant, James, F.I.C., Oaklands, Gardner-road, Prestwich, near Manchester
1887			Gravill, Edward Day, 42, Walmsley-street, Hull
1882			‖Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900	Trans.		Gray, Robert Whytlaw, 7, Orme-court, Bayswater, W.
1892	Trans.		Gray, Thomas, Prof., D.Sc. (Glas.), Ph.D. (Jena), The Technical College, Glasgow
1895			Greaves, William Abraham, 23A, Broad-bank, Louth, Lincs.
1890			Green, Alfred Henry, A.I.C., Oaklands, Lowton, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, Prof., Hon. M.Sc. (Vict.), F.I.C., The University, Leeds; and 49, Cardigan-road, Headingley, Leeds
1902	Trans.		Green, Clarence James, B.Sc. (Vict.), c/o Messrs. Nicholson and Co., Beaumont Works, St. Albans
1905			Green, Ernest, 113, Hulton-street, Moss Side, Manchester
1902			Green, George Felix Dudbridge, A.I.C., c/o Messrs. Davey and Co., Gainsboro'-road, Hackney Wick, N.E.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, A.R.S.M., West Clyne, Stretford, Manchester
1878			Green, Lawrence, Lower Tovil, Maidstone

Date of Election.			
1907			Green, William Heber, D.Sc. (Melbourne), The University, Melbourne, Australia
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey
1885			Greenway, Thomas John, F.I.C., 60, Brookman's-buildings, Grenfell-street, Adelaide, South Australia
1894	Proc.		Greeves, Alfred, 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D. and B.S. (Dun. and Cape of Good Hope), M.R.C.S. and D.P.H. (Eng.), B.Sc., Colonial Secretary's Office, Cape Town, S. Africa
1907			Gregory, Joshua Craven, B.Sc. (Lond.), F.I.C., 126, Woodlands-road, Glasgow
1906	Trans.		Gregory, Thomas William Diggle, Lynton, Basford-park, Stoke-on-Trent
1874			Greville, Henry Leicester, F.I.C., 39, Croft-road, Bromley, Kent
1896			Grice, Walter Thomas, 9, Dalhousie-square, Calcutta, India
1907			Grieb, Christopher Maurice Walter, B.Sc. (Lond.), A.I.C., 33, Torrington-park, North Finchley, N.
1888			‖Griffith, David Agnew, The Houghlands, Kelsall, Chester
1905			Griffiths, John, B.Sc. (Wales), The College, Cleobury Mortimer, Salop.
1902			Griffiths, John Thomas, 9, Greenhill-avenue, Tenby, South Wales
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 3, Hill-side, Lancaster
1902			Grimwade, Wilfrid Russell, B.Sc. (Melbourne), 342–346, Little Flinders-street, Melbourne, Australia
1880			Grimwood, Robert, F.I.C., Chemical Department, London County Council, 40, Craven-street, W.C.
1893			Grimwood, Robert George, F.I.C., 43, Leaside-avenue, Muswell Hill, N.
1906			Grindley, Harry Sands, Prof., D.Sc. (Harvard), B.Sc. (Illinois), State University, Urbana, Ill., U.S.A.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire
1900			Gritton, Henry Bertie, The Royal Mint, Sydney, N.S.W.
1895			Grossman, Edward Henry, 12, Alfred-place-west, South Kensington, S.W.
1871	Trans.	C.1877-8 V.P. 1899-1902.	‖Groves, Charles Edward, F.R.S., F.I.C., Kennington Green, S.E.
1902			Groves, Samuel Ernest, Ingleside, Bridle-road, South Boldon, Co. Durham
1901			Groves, William Peer, B.A. (Cantab.), Green Bank, Plumbley, Cheshire

Date of Election.		
1906		Grubb, David Paton, B.Sc. (Edin.), A.R.S.M., 1, Windsor-hill, Newry, Ireland
1897		Grundey, Frederick Roscoe, B.Sc. (Vict.), 33, Woodburn-square, Douglas, Isle of Man
1903		Grundy, Frank Barnes, F.I.C., Victoria Mills, Bredbury, near Stockport
1897		Guest, Edward Graham, M.A. (Cantab.), B.Sc. (Lond.), 5, Newbattle-terrace, Edinburgh
1902		Gumersall, Edward, 21, New-road, Rochester, Kent
1895		Gunn, Alexander, 4, Ferndale-road, Clapham, S.W.
1902		Gunn, Gilbert, 181, Bury-new-road, Heywood, Lancs.
1906		Gupta, Hem Chandra Dutt, Prof., M.A. (Calcutta), Tej Narayan Jubilee College, Bhagalpur, Bengal, India
1899		Gurney, Elliott Henry, Agricultural College, Gatton, Queensland, Australia
1898		Guthrie, Alexander, B.Sc. (Lond.), Inglewood, Eaton-road, Coventry
1888	Trans.	Guthrie, Frederick Bickell, F.I.C., Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1904	Trans.	Guthrie, John Monteath, 199, Ferry-road, Leith, N.B.
1904	Trans.	Guttmann, Leo Frank, Ph.D. (Heidelberg), A.C.G.I., F.I.C., The College of the City of New York, New York City, U.S.A.; and 18, Aberdare-gardens, N.W.
1897		Guttmann, Oscar, M.Inst.C.E., F.I.C., 12, Mark-lane, E.C.
1902	Trans.	Haas, Paul, D.Sc. (Lond.), Ph.D. (Freiburg), 11, Westbourne-park-road, W.
1874		Habirshaw, William Martin, 341, Madison-avenue, New York, U.S.A.
1894		Hadley, Arthur, c/o Messrs. Crowley & Co., Ltd., The Brewery, Alton, Hants.
1898		Hadley, Edwin Bernard, Dalham Villa, Granville-road, Southfields, S.W.
1893		‖Hadley, Henry Edwin, B.Sc. (Lond.), A.R.C.S., School of Science, Kidderminster
1886	Trans.	Haga, Tamemasa, Prof., D.Sc. (Japan), College of Science, University of Tokio, Japan
1881		Hailes, Alfred James de, F.I.C., 15, Red Lion-square, W.C.
1892		Haines, Walter Stanley, Prof., c/o Rush Medical College, Chicago, Ill., U.S.A.
1876	Trans.	Hake, Henry Wilson, Ph.D. (Giessen), F.I.C., Westminster Hospital Medical School, Caxton-street, S.W.
1893		ale, Henry Ormsby, Oundle School, Northants.

Date of Election.			
1891	Trans.	C. 1904-7	Hall, Alfred Daniel, M.A. (Oxon.), Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.
1889			Hall, Allan Twistleton, c/o Messrs. Sissons Bros. and Co., Ltd., Hull
1891			Hall, Archibald, F.I.C., 34, Bishopsgate-street, E.C.
1889	Trans.		Hall, John Albert, M.Sc. (Manc.), Victoria Chemical Works, Victoria, British Columbia
1903			Hall, John Thomas, West View, Stanwell, Staines
1907			Hall, Joseph Henry, B.Sc. (Lond.), 84, The Grove, Wandsworth, S.W.
1906			Hall, Octavius, L.R.C.P. and L.R.C.S. (Edin.), L.F.P.S. (Glas.), D.P.H. (R.C.P.S.I.), 6, Devonshire-villas, Plymouth
1906			Hall, Richard John, M.Sc. (Vict.), F.I.C., Sandycroft, Serpentine-road, Egremont, Liverpool
1876			Hall, Samuel, F.I.C., East London Soap Works, Bow, E.
1899			‖ Hall, Samuel Godfrey, 19, Aberdeen-park, Highbury, N.
1893			Haller, Albin, Prof., 1, Rue de Goff, Paris
1886			Halliburton, William Dobinson, Prof., M.D., B.Sc. and F.R.C.P. (Lond.), M.R.C.S., (Eng.), F.R.S., Church Cottage, 17, Marylebone-road, N.W.
1897			Halliwell, Edward, F.I.C., c/o Ribble Joint Committee, 2, Stanley-place, Preston
1902			Hallowell, Thomas Butterworth, Ladyshawe House, New Mills, West Stockport
1900			Halstead, Reginald Gordon, 12 and 16, Coleman-street, E.C.
1890	Trans.		Hambly, Frederick John, F.I.C., c/o The Electric Reduction Co., Buckingham, Quebec, Canada
1906			Hamer, John, 158, Darwen-road, Bromley Cross, near Bolton, Lancs.
1888	Trans.		Hamilton, James Cullen, Barrows-green, near Kendal, Westmoreland
1898			Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks.
1897			Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans.		Hamlet, William Mogford, F.I.C., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1904			Hammond, Harold Sankey, Agricultural Experiment Station, Kingston, Rhode Island, U.S.A.
1901			Hammond, Herbert Blackmore, 41, St James'-street, Dover
1857			Hanbury, Cornelius, F.I.C., Plough-court, Lombard-street, E.C. ; and Dynevor House, Richmond, Surrey
1900			Handcock, Walter Augustus, A.I.C., Pentlands, 39, The Avenue, Beckenham, Kent
1895	Trans.		Hanes, Edgar Septimus, F.I.C., 22, Lyncroft-mansions, Lyncroft-gardens, Hampstead, N.W.

Date of Election.			
1896			Hanger, Ralph Hamilton, Hawthorn-villa, Newland, Hull
1900			Hanley, John, F.I.C., 74, Rowson-street, New Brighton, Cheshire
1902	Trans.		Hann, Archie Cecil Osborn, 54, Wood-vale, Forest Hill, S.E.
1872	Trans.		||Hannay, James Ballantyne, F.I.C., Cove Castle, Loch Long, N.B.; and Whitehall Club, S.W.
1889			||Hanson, Alfred Miall, The Marjorie, Whalley, near Blackburn
1901	Trans.		Hanson, Edward Kenneth, M.A. (Cantab.), F.I.C., Woodthorpe, Royston-park-road, Hatch End, Middlesex
1906			Hanson, Harold Norman, Field Head, Brighouse, Yorks.
1895			Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on-Tees
1897			Harbord, Frank William, F.I.C., Surbiton House, Englefield Green, Surrey
1859	Trans.	S. 1865-73 V.P. 73-6, 80-3, 92-5 P. 1895-7	||Harcourt, Augustus George Vernon, M.A. (Oxon.), Hon. D.C.L. (Dun.), Hon. LL.D. (Montreal), F.R.S., F.I.C., St. Clare, Ryde, Isle of Wight
1887	Trans.	C. 1902-05	||Harden, Arthur, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C., 2, Marlborough-road, Richmond, Surrey
1902			Harding, Herbert, B.Sc. (Lond.), 47, Streathbourne-road, Upper Tooting, S.W.
1885			Hards, William Benjamin, B.A. (Lond.), Board of Education, Whitehall, S.W.
1892			Hardy, James Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1874			Hargreaves, Andrew Fuller, Esk Hill, Rosslyn, Midlothian
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes, Lancs.
1884			Hargreaves, John, F.I.C., Widnes, Lancs.
1901			Hargreaves, William Arthur, M.A., B.C.E. (Melbourne), F.I.C., Government Analyst, Adelaide, S. Australia
1901			Harker, George, D.Sc. (Lond.), 35, Boulevarde, Petersham, Sydney, N.S.W.
1876			||Harland, Robert Henry, F.I.C., 37, Lombard-street, E.C.
1878			||Harland, William Dugdale, 48, King-street, Manchester
1897			||Harley, Vaughan Berkeley, Prof., M.D. (Edin.), M.R.C.P. (Lond.), 25, Harley-street, W.
1897			Harman, Harold Wallis, Felday, Prentis-road, Streatham, S.W.
1903			Harmer, Francis Gerald, Middle Class School, Vernon-road, Leeds
1904			Harold, Frederick Clarkson, 1, Oak-road, Woodhey, near Birkenhead
1899			Harper, Henry Winston, M.D. (Virginia), The University of Texas, Austin, Texas, U.S.A.

Date of Election.		
1897		Harrie, Harold William, 300, Christchurch-road, Boscombe, Bournemouth
1907		Harrington, Arthur George, Rochford, Westbury-road, Ealing, W.
1897		Harrington, B. J., Prof., M.A., Ph.D., McGill University, Montreal, Canada
1896		Harrington, William, 9, Edgehill-terrace, Bransby, Whitehaven
1881		Harrington, William Bury, Leeview, Montenotte, Cork
1906		Harris, Frederick James, 1, Alexandra-terrace, Bath-road, Exeter
1896		Harris, Frederick William, F.I.C., Sanitary Chambers, Glasgow
1893		Harris, Harold, The Birmingham Metals and Munitions Co., Ltd., Ammunition Factory, Streetly, nr. Sutton Coldfield, Birmingham
1895		Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia
1894		Harris, Sydney Walters, Devon House, Walter-road, Swansea
1878		‖Harris, Thomas Frederick, B.Sc. (Lond.), Waterford House, Aylsham, Norfolk
1888		‖Harrison, Albert, Delamere, Grove-road, South Woodford, Essex
1894	Trans.	Harrison, Edward Frank, B.Sc. (Lond.), F.I.C., 55, Chancery-lane, W.C.; and Langholm, Purley Oaks-road, S. Croydon
1883		‖Harrison, Hugh Erat, B.Sc. (Lond.), 28, Sussex-place, Regent's Park, N.W.; and Faraday House, Charing Cross-road, W.C.
1901		Harrison, John Ansted, B.Sc. (Lond.), A.R.C.S., Brayton House, Wellington-row, Whitehaven
1888		Harrison, John Burchmore, C.M.G., M.A. (Cantab), F.I.C., Government Laboratory, Georgetown, Demerara, British Guiana
1902		Harrison, Walter Ernest, 15, Lansdowne-road, Handsworth, Birmingham
1876	Trans.	Harrow, George Harrow Unwin, Ph.D. (Würzburg), F.I.C., Messrs. Allsopp and Sons' Brewery, Burton-on-Trent
1901		Harry, Frederick Thomas, 106, Sandmere-road, Clapham Common, S.W.
1905		Hart, Alfred, M.A., B.Sc. (Melbourne), Norman-avenue, Hawksburn, Victoria, Australia
1886		Hart, Bertram Harvey, Rosslyn, High-street, Sidcup, Kent
1869		‖Hart, Frederic William, 168, Stoke Newington-road, N.
1900		Hart, Herbert William, 5, Cambridge-road, Ansdell, Lytham, Lancs.
1891		Hart, William Beamont, F.I.C., Laboratory, 8, Exchange-street, Manchester
1882		Hartley, Arthur, The Brewery, Emsworth, Hants.
1897		Hartley, Ernald George Justinian, B.A. (Oxon.), The Bungalow, Foxcombe Hill, near Oxford
1899	Trans.	Hartley, Harold Brewer, M.A. (Oxon.), Balliol College, Oxford

Date of Election.			
1897			Hartley, Thomas, B.Sc. (Lond.), F.I.C., Swindon and North Wilts. Technical School, Swindon
1866	Trans.	C. 1877-80 V.P. 90-3	†Hartley, Walter Noel, Prof., Hon. D.Sc. (R.U.I.), F.R.S., F.I.C., Royal College of Science, St. Stephen's-green, East; and 10, Elgin-road, Dublin
1890	Trans.		Hartog, Philip Joseph, B.Sc. (Lond. and Vict.), 22, Brondesbury-villas, N.W.
1900	Trans.		Hart-Smith, James, A.R.C.S., F.I.C., 4, Grafton-mansions, Venn-street, Clapham, S.W.
1900	Trans.		Harvey, Alfred William, 13, Pendrell-road, St. Catherine's-park, Hatcham, S.E.
1885			Harvey, Ernest William, A.R.S.M., Stoneleigh, 23, Grove-road, Clapham Park, S.W.
1881			Harvey, Sidney, F.I.C., Watling House, Canterbury
1907			Harvey, Thomas Featherstone, 84, Henry-road, West Bridgford, Nottingham
1894			Harvey, William Pellew, 62, London Wall, E.C.
1894			Hatfield, John Adams, F.I.C., c/o Messrs. J. Lysaght, Ltd., Orb Iron Works, Newport, Mon.
1892			Hatton, William Percy, c/o Messrs. W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred Edward, M.D. (Brussels), L.R.C.P. (Edin.), 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, Edward, D.Sc. (Vict.), Sunnyside, Norman-road, Runcorn, Cheshire
1898			Haworth, John, 17, Knaresboro'-road, Millhouses, near Sheffield
1905	Trans.		Hawthorne, John, Municipal Technical Institute, Belfast.
1905			Hayman, Jack Vernon Johnson, A.C.G.I., Tringhurst, Cranleigh, Surrey
1900			Haynes, James Herbert, B.Sc. (Vict.), Sennen, 65, Kennington-avenue, Ashley Down, Bristol
1906			Hayworth, William Prince, A.I.C., 119, Clapton Common, N.E.
1903			Heasman, Harold Montague, 2, Broadway, Westminster, S.W.
1891			Heath, John William, 1, Carlyle-square, Chelsea, S.W.
1898			Heaton, John, Southcliffe, Roker, Sunderland
1902			Heaton, Noël, B.Sc. (Lond.), 20, Baker-road, Harlesden, N.W.
1906	Trans.		Hedley, Edgar Percy, A.R.C.S.I., 6, Royal-terrace-west, Kingstown, Co. Dublin
1899			Hedley, George Ward, M.A. (Oxon.), The College, Cheltenham
1905			Heely, Frederick William, 10, Yarborough-street, Grimsby

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† Longstaff Medallist, 1906.

Date of Election.			
1876		C. 1895-9	Hehner, Otto, F.I.C., 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D. (Heidelberg), A.R.S.M., F.I.C., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, I.S.O., F.I.C., Simonstone, 27, Hammelton-road, Bromley, Kent
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, James William, 3, Tavistock-road, Croydon
1899			Hembrough, James, A.R.C.S., A.I.C., 7, Park-view, Beeston-hill, Leeds
1900			Hemingway, Frank Christian Richard, 133, Front-street, New York City, U.S.A.
1898	Trans.		Hemmy, Arthur Stanley, Prof., B.A. (Cantab.), M.Sc. (Melbourne), Government College, Lahore, India
1885	Trans.		‖Henderson, George Gerald, Prof., M.A., D.Sc. (Glas.), F.I.C., The Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, Ph.D. (Münich), B.Sc. (St. Andrews), c/o Horlick's Malted Milk Co., Racine, Wisconsin, U.S.A.
1905			Henderson, James Alexander Russell, Prof., B.Sc. (Glas.), Chihli Provincial College, Paotingfu, North China
1900	Trans.		Henderson, John Brownlie, F.I.C., Government Analyst, Brisbane, Queensland
1892			Hendrick, James, B.Sc. (Lond.), F.I.C., Marischal College, Aberdeen
1903			Hendrickson, Arthur V., The Gas Works, Lower Sydenham, S.E.
1901			‖Henley, The Hon. Francis Robert, M.A. (Oxon.), A.I.C., 9, Beaufort-gardens, S.W.
1905			Hennings, Carl Richard, Ph.D. (Freiburg), 19, St. Dunstan's-hill, E.C.
1899	Trans.		Henry, Thomas Anderson, D.Sc. (Lond.), 70, Doneraile-street, Fulham, S.W.
1905	Trans.		Henstock, Herbert, M.Sc. (Vict.), Ph.D. (Zürich), The University, Leeds
1904			Henzell, Archie Willoughby, Tintagel, Rooksmead-road, Sunbury-on-Thames
1895			Heriot, Thomas Hawkins Percy, 37, Church-crescent, Muswell Hill, N.
1871			Herman, Douglas, F.I.C., Rainhill, Lancs.
1876	Trans.	C. 1892-3	Heron, John, B.E. (R.U.I.), F.I.C., 110, Fenchurch-street, E.C.
1906			Herty, Charles Holmes, Prof., Ph.D. (Johns Hopkins Univ.), Ph.B. (Georgia), University of North Carolina, Chapel Hill, N.C., U.S.A.
1905			Hetherington, Arthur Lonsdale, B.A. (Cantab.), Government Collegiate School, Rangoon, Burma

Date of Election.			
1892	Trans.	C. 1903-05	Hewitt, John Theodore, M.A. (Cantab.), D.Sc. (Lond.), Ph.D. (Heidelberg), 7, The Avenue, Surbiton, Surrey
1900			Hewitt, Samuel, 53, Dover-street, Unthank-road, Norwich
1892			Hewlett, John Cooke, 35–42, Charlotte-street, Great Eastern-street, E.C.
1883	Trans.	C. 1897-1901	‖Heycock, Charles Thomas, M.A. (Cantab.), F.R.S., 3, St. Peter's-terrace, Cambridge
1876	Trans.		Hibbert, Walter, F.I.C., 144, Walm-lane, Willesden Green, N.W.
1881			‖Hiddingh, Michael, Newlands, near Capetown, S. Africa
1905			Higgins, John Michael, 39, Queen-street, Melbourne, Australia
1907			Higham, Richard, 133, Mauldeth-road, Withington, Manchester.
1882			‖Hill, Alexander, 4, Broad-street-place, E.C.
1896	Trans.		Hill, Arthur Croft, M.A., M.D. and B.S. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 169, Cromwell-road, S.W.
1906	Trans.		Hill, Arthur Edwin, Ashdene, Wilmington Lane, Northwich, Cheshire
1896			‖Hill, Charles Alexander, B.Sc. (Lond.), F.I.C., 15, Brunswick-gardens, Kensington, W.
1896	Trans.		Hill, Ernest George, Prof., B.A. (Oxon.), Muir College, Allahabad, India
1905			Hill, William Basil, Eastfield, Stockton-lane, York
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, S.W.
1892			‖Hills, Harold Fletcher, Commercial Gas Works, Stepney, E.
1906	Trans.		Hills, James Stuart, A.I.C., 225, Oxford-street, W.
1898			Hills, Thomas Herbert, 6, Eliot Park, Blackheath, S.E.
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, John William, A.R.S.M., 15, Fawcett-street, Redcliffe-gardens, S.W.
1903			Hindmarsh, Leonard King, M.A. (Oxon.), 13, Westfield-grove, Wakefield
1906			Hines, Charles Percy, B.Sc. (Lond.), The Grammar School, Dartford, Kent
1900			Hinks, Percy John, A.R.C.S., F.I.C., Woodstock, Beaconsfield-road, Blackheath, S.E.
1894			Hirsch, Charles Theodore William, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Charlinch, Rectory-road, Woolwich, S.E.
1870			Hislop, George Robertson, Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, Robert Findlay, Craigielea, Paisley
1883			‖Hobbs, Bedo, Lamb Brewery, Chiswick, W.
1905			Hobsbaum, Isaac Berkwood, 79, Claremont-road, Forest-gate, E.
1901			Hobson, Edwin, Howdendyke, Howden, Yorks.

Date of Election.			
1884			Hodges, Herbert John, 224, The Rye, Peckham, S.E.
1882	Trans.		‖Hodgkin, John, F.I.C., 97, Hamlet-gardens-mansions, Ravenscourt Park, W.
1879	Trans.	C. 1883-5, 1907-	Hodgkinson, William Richard Eaton, Prof., Ph.D. (Würzburg), F.I.C., 18, Glenluce-road, Blackheath, S.E.
1886			Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, Harry McAlpin, Brooklands, Greenmount, near Bury, Lancs.
1873			‖Hodgson, Henry Tylston, M.A. (Cantab.), Harpenden, Herts.
1904			Hodgson, Thomas Reginald, B.A. (Cantab.), A.I.C., Analytical Department, School of Brewing, The University, Birmingham
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D. (Paris), 62, Champs Elysées, Paris
1904			Hoit, Alfred Henry, 4, Montgomerie-road, Southsea
1876			Holcroft, Harold, M.A. (Cantab.), Parkdale, Wolverhampton
1901			Holdcroft, George Frederick, c/o The Hull Oil Manufacturing Co., Ltd., Stoneferry, Hull
1885			Holgate, Thomas, 5, Victoria-street, Westminster, S.W.
1876			Holland, Philip, F.I.C., 22, Taviton-street, Gordon-square, W.C.
1902			Hollingworth, David Vincent, Gas Offices, Bloom-street, Salford
1905			Hollins, Cecil, 34 Beamsley-road, Frizinghall, Bradford
1891			Holloman, Frederick Richard, Liston-street, Plaistow, E.
1886			Holloway, George Thomas, A.R.C.S., F.I.C., 57 and 58, Chancery-lane, W.C.
1895			Holme, Arthur Edward, M.A. (Oxon.), The Wheelwright Grammar School, Dewsbury
1897	Trans.		Holmes, John, Government Laboratory, Clement's Inn Passage, W.C.
1898	Trans.		Holroyd, George William Fraser, B.A. (Oxon.), 20, Creffield-road, Ealing, W.
1902	Trans.		‖Holt, Alfred, jun., B.A. (Cantab.), Crofton, Aigburth, Liverpool
1893			Holthouse, Harold Bertram, 12, Melton-grove, West Bridgford, Notts.
1898			Homfray, David, B.Sc. (Lond.), F.I.C., The Ings, Misterton, near Gainsborough
1878			Hooker, Ayerst Henham, F.I.C., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel Cox, Ph.D., 4422, Chestnut-street, Philadelphia, U.S.A.
1883			‖Hooper, David, F.I C., Curator, Economic and Art Section, Indian Museum, 1, Sudder-street, Calcutta, India
1888		C. 1907-	‖Hooper, Egbert Grant, F.I.C., 16, Royal-avenue, Sloane-square, S.W.

Date of Election.			
1891			‖Hooper, Ernest Frederick, Wear Fuel Works, South Dock, Sunderland
1907			Hooton, William Marrs, M.A. (Oxon.) M.Sc. (L'pool), A.I.C., Repton School, Repton, Burton-on-Trent
1907			Hope, Geoffrey Dodleston, B.Sc. (Vict. and L'pool), Ph.D. (Halle), Heath Heys, Oxton, Birkenhead
1906			Hopkins, Frederick Gowland, M.A. (Cantab.), M.B., D.Sc., and L.R.C.P. (Lond.), M.R.C.S. (Eng.), F.R.S., F.I.C., Stafford House, Wordsworth-grove, Newnham, Cambridge
1902			Hopwood, Arthur, A.R.C.S., F.I.C., Bramhall, Victoria-road, Tunstall, Stoke-on-Trent
1904			Horn, George Mathieson, Ivylands, Epping, Essex
1894			‖Hornby, Richard, M.A. (Oxon.), Haileybury College, Hertford
1904			Horrod, George William Thomas, 13, Lyric-road, Barnes, S.W.
1897			Horseman, James Walter, County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901	Proc.		Horton, Edward, 10, Smith-street, Chelsea, S.W.
1892			Horwill, Edgar Edward C., 6, Devereux-road, New Wandsworth, S.W.
1902			Hosking, Arthur Francis, c/o The Tasmania Gold Mining Co., Ltd., Beaconsfield, Tasmania
1886			‖Hoskins, Arthur Percy, F.I.C., Clonlee, Rosetta-park, Belfast
1907			Houghton, Edward, Glenhyrst, 106, Saltergate, Chesterfield
1871			Houlder, William Washington, North Hyde House, Southall
1901			Houldershaw, Arthur, 4, Beacon-street, Low Fell, Gateshead-on-Tyne
1887	Proc.		Houlding, William, B.Sc., Arisaig, Aigburth Drive, Liverpool
1896			Howard, Albert, The Agricultural Research Institute, Pusa, Bengal, India
1882			‖Howard, Alfred Gravely, Burnt House, Chigwell, Essex
1901			Howard, Bernard Farmborough, F.I.C., Quantocks, Woodford Green, Essex
1870		C. 1875-9, 83-5, 98-1902. V.P. 1886-9, 1903-06	‖Howard, David, J.P., F.I.C., Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, David Lloyd, Little Friday Hill, Chingford, Essex
1889			Howard, George William, Calverley, Tunbridge Wells
1875			Howard, Thomas, F.I.C., 50, Ellington-street, Liverpool-road, N.
1903			Howarth, John George, Danes Dyke, Chart-road, Reigate, Surrey
1882			Howe, James Lewis, Prof., M.D. (Louisville), Ph.D. (Göttingen), B.A. (Amherst), Washington and Lee University, Lexington, Va., U.S.A.

Date of Election.		
1880		Howell, Reginald, 95A, Southwark-street, S.E.
1905		Howgate, James Henry, B.A. (Lond.), The Grammar School, Huntingdon
1876		Howie, William Lamond, 26, Neville-court, Abbey-road, N.W.
1903		Howorth, Franklin Wise, 46, Lincoln's Inn Fields, W.C.
1889		‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889		Hoyles, Henry Richardson, 10, Fore-street, Wellington, Somerset
1907		Hoyten, William James, M.A., M.R.C.S. (Eng.), F.R.C.P., (Lond.), 37, Revelstoke-road, Wimbledon Park, S.W.
1907		Hubbard, The Hon. Raymond Egerton, Addington Manor, Winslow, Bucks.
1871		‖Hudleston, Wilfrid Hudleston, M.A. (Oxon.), F.R.S., 8, Stanhope-gardens, S.W.
1900		Hudson, Edmund Foster, M.A. (Cantab.), Churcher's College, Petersfield, Hants.
1878		Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899	Trans.	Hübner, Julius, M.Sc. (Manc.), F.I.C., Ash-villa, Cheadle Hulme, Cheshire
1903		Hughes, Edwin Reginald, 106, Queen Victoria-street, E.C.
1907		Hughes, Francis Townshend Cunynghame, Major, The Royal Mint, Calcutta, India
1894	Trans.	Hughes, Frank, c/o Khedivial Agricultural Society, P.O. Box 63, Cairo, Egypt
1880	Trans.	Hughes, George Henry, 155, Fenchurch-street, E.C.
1868		Hughes, John, F.I.C., Analytical Laboratory, 79, Mark-lane, E.C.
1906		Hughes, John Gerard, 2, Canute-road, Southampton
1896		Hughes, Joshua Arthur, 1, Bridewell-street, Bristol
1885		Hughes, Theophilus Vaughan, A.R.S.M., F.I.C., 26, Barnsley-road, Edgbaston, Birmingham
1882		Hughes, Thomas, F.I.C., Borough Analyst's Office, 31, Loudoun-square, Cardiff
1904		Hulme, John, 5, Duke-street, Macclesfield
1907		Humphries, Herbert Brooke Perren, B.Sc. (Lond.), A.R.C.S., 117, Avenell-road, Highbury, N.
1883		Humphrys, Norton Henry, 4, The Paragon, Wilton-road, Salisbury
1899		Hunter, Archibald Glen Kidston-, Public Analyst, Freemantle, W. Australia
1883		Hunter, John, F.I.C., 37, Chambers-street, Edinburgh
1885		Hunter, Matthew, M.A. (Oxon.), Rangoon College, Rangoon, Burma
1878		Huntington, Alfred Kirby, Prof., A.R.S.M., F.I.C., Metallurgical Laboratory, King's College, Strand, W.C.

Date of Election.		
1893	Trans.	Huntly, George Nevill, B.Sc. (Lond.), A.R.C.S., F.I.C., 96, Gower-street, W.C.; and 56, Sheen-road, Richmond, Surrey
1902	Trans.	Hurtley, William Holdsworth, D.Sc. (Lond.), St. Bartholomew's Hospital, E.C.
1861		Huskisson, Henry Owen, F.I.C., 5, Gordon-square, W.C.
1907		Hussey, Arthur Vivian, A.C.G.I., c/o British Aluminium Co., Ltd., Foyers, N.B.
1900		Hutchin, Henry William, Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, M.A. (Cantab.), B.Sc., 3, Windsor-road, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A. (Cantab.), Ph.D. (Würzburg), Pembroke College, Cambridge
1884		‖Hutchinson, Christopher Clarke, F.I.C., 13, The Boltons, South Kensington, S.W.
1901	Trans.	Hutton, Robert Salmon, D.Sc. (Vict.), The University, Manchester
1901		Hyder, Alfred James, B.Sc. (Lond.), Dinwoodie, Connaught-avenue, Chingford, Essex
1900		‖Ichioka, Tajiro, Prof., 19, Maruyama Shinmachi, Hongo, Tokio, Japan
1888		Idris, Thomas Howell Williams, M.P., 110, Pratt-street, Camden Town, N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1889	Trans.	‖Ingle, Herbert, B.Sc. (Leeds), F.I.C., Government Agricultural Chemist, Pretoria, Transvaal, S. Africa
1904	Trans.	Inglis, John Kenneth Harold, M.A., D.Sc. (Edin.), B.Sc. (N.Z.), University College, Reading
1901		Ingram, Beresford, Department of Agriculture and Technical Instruction, 2, Kildare-place, Dublin
1897	Trans.	Innes, William Ross, D.Sc. (Vict.), Ph.D. (Heidelberg), F.I.C., 6, Griffiths-road, Wimbledon, S.W.
1901		‖Ionides, Stephen Archigenes, Minas Treolotes y Anexas, Santa Barbara, Chihuahua, Mexico
1906		‖Irving, Henry Carlyle, B.A. (Oxon.), 14, Heath Hurst-road, Hampstead, N.W.
1883		‖Irwin, Wilfred, Inglehurst, Higher-lane, Stand, Manchester
1892		‖Isaac, John F. V., M.A. (Oxon.), Barton Court, Abingdon, Berks.
1885		Ivatt, Albert, M.A. (Cantab.), The Engadine, Histon, Cambridge
1905		Jack, Maurice Brooks, Bedford Villa, 74, Park-avenue-south, Crouch End, N.
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex

Date of Election.			
1883			‖Jackson, Alfred Henrick, Prof., B.Sc. (Vict.), M.Inst.E.E., The Electrical Engineering School, 349, Collins-street, Melbourne, Australia
1894	Trans.		Jackson, David Hamilton, M.A. and B.Sc. (N.Z.), Ph.D. (Heidelberg), 73, Parliament-hill, N.W.
1882			Jackson, Edward, F.I.C., Raven's Clift, Oxford-road, Moseley, Birmingham
1907			Jackson, Ernest Wilfrid, 3, Leven-street, Saltburn-by-the-Sea, Yorks.
1900	Trans.		Jackson, Henry, M.A. (Cantab.), Downing College, Cambridge
1884	Trans.		Jackson, Herbert, Prof., F.I.C., Chemical Laboratory, King's College, Strand, W.C.
1881			‖Jackson, Raynsford Valentine, M.A. (Oxon.), c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			Jackson, Samuel, A.R.C.S., F.I.C., c/o H. S. Duncan, Esq., Roundhay, Harrington's-road, Chetput, Madras, India
1907			Jackson, Victor George, 21, Frankfurt-road, Herne Hill, S.E.
1902			Jackson, William Brannan, Glengowan, Caldercruix, N.B.
1903			Jackson, William Henry, 73, Church-street, West Hartlepool
1887			‖Jadhava, Khasberao B., M.R.A.C., Nawasari, Bombay Presidency, India
1900			Jaffé, Adolf, 8, Leyburn-grove, Shipley, Yorks.
1878	Trans.		Jago, William, Barrister-at-Law, F.I.C., 3, Crown Office-row Temple, E.C. ; and 17, Wilbury-avenue, Hove, Sussex
1895			James, Alfred, 2, Broad-street-place, E.C.
1904	Trans.		James, Thomas Campbell, M.A. (Cantab.), B.Sc. (Wales), University College of Wales, Aberystwith
1904			James, Walter Richmond, 20 Parkdale, Wolverhampton
1878			Jameson, Alexander, 134, Castellain-mansions, Sutherland-avenue, W.
1901			Jamieson, James Sprunt, F.I.C., Government Laboratory, Durban, Natal
1879	Trans.	C. 1882-5 F.S. 85-91 V.P. 95-9	†‖Japp, Francis Robert, Prof., M.A., Hon. LL.D. (St. Andrews), F.R.S., F.I.C., The University, Aberdeen
1902			Jardin, David Smith, A.R.C.S.I., F.I.C., Rathgar House, Rathgar, Co. Dublin
1902			Jardine, Douglas Kennedy, B.Sc. (Vict.), c/o Daily Chronicle Office, Georgetown, Demerara, British Guiana
1882			Jarmay, Gustav, F.I.C., Hartford Lodge, Hartford, Cheshire
1905			Jarrard, William John, B.Sc. (Lond.), A.R.C.S., The University, Sheffield
1898			Jee, Edwin Charles, D.Sc. (Lond.), F.I.C., 39, Pepys-road, New Cross, S.E.

† Longstaff Medallist, 1891.

Date of Election.		
1896	Proc.	Jeffers, Ernest Haynes, 87, Kyrle-road, West-side, Clapham Common, S.W.
1901	Proc.	Jemmett, William Henry Coutts, M.A. (Cantab.), Sebright, Sunningfields-road, Hendon, N.W.
1891	Trans.	Jenkins, Henry Charles, A.R.S.M., Assoc. M. Inst. C.E. Cusgarne, Perranwell, Cornwall
1904		Jenkins, Herbert, 15, Old Bond-street, Bath
1892		‖Jenkins, John H. B., Chemical Laboratory, Great Eastern Railway Works, Stratford, E.
1906	Trans.	Jenkinson, Ernest Arthur, Dauntsey Agricultural School, West Lavington, S.O., Wilts.
1894		Jenks, Robert Leonard, A.C.G.I., F.I.C., Central Excise Laboratory, Kasauli, Punjaub, India
1907		Jennings, John Atkinson, 61, Gleneagle-road, Streatham, S.W.
1907		Jennings, Sidney James, B.Sc. (Lond.), 367, Queen's-road, New Cross, S.E.
1903		Jennings, Walter Ernest, 8, Rawdon-terrace, Ashby-de-la-Zouch
1894		Jennison, Francis Herbert, F.I.C., 26, Derby-crescent, Kelvinside, near Glasgow
1907		Jensen, Charles William Lamb, c/o Oakhill Brewery Co., Oakhill, near Bath
1897	Trans.	‖Jerdan, David Smiles, M.A. (Glas.), D.Sc. (Vict.), Ph.D. (Heidelberg), c/o Messrs. J. & G. Cox, Ltd., Gorgie Mills, Edinburgh
1898		Jessop, Samuel Morton, 19, Burton-street, Wakefield
1879		Jewson, Francis Albert Bowen, F.I.C., 14, Norfolk-square, Brighton
1901		Johnson, Charles Harold, M.D., C.M., F.R.C.S. and M.R.C.P. (Edin.), Beaumont, Northcote, Melbourne, Australia
1895		Johnson, Frederick Edward, Holly House, Cottingham, Hull
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), 5 and 6, Fawkes-buildings, Great Tower-street, E.C.
1883		Johnson, James Edward, F.I.C., 40, Idmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1904		Johnson, John Richard, 86, Waldegrave-road, Preston-park, Brighton
1897		Johnson, Otis C., Prof., 730, Thayer-street, Ann Arbor, Mich., U.S.A.
1866		‖Johnson, Samuel Henry, The Warren-hill, Loughton, Essex
1906		Johnston, Archibald McArthur, Box 108, Germiston, Transvaal, S. Africa
1904		Johnston, John Haslam, M.Sc. (Vict.), F.I.C., Public Offices, Hampton, Middlesex
1896		Johnstone, James, F.I.C., Braehead, Parkhill, Rutherglen

Date of Election.		
1892		Johnstone, William George, c/o Thomas Manwell, Esq., 8, Great Winchester-street, E.C.
1901	Trans.	Jollyman, Walter Henry, F.I.C., P.O. Box 3782, and Government Laboratory, P.O. Box 1080, Johannesburg, S. Africa
1903		Jones, Alfred Owen, The Hill, Scotby, near Carlisle
1905		Jones, Bernard Mouat, B.A. (Oxon.), Prof., Government College, Lahore, India.
1898		Jones, Edward, B.Sc. (Lond.), F.I.C., 15, Macaulay-road, Clapham, S.W.
1906		Jones, Edward Rees, Llangedwyn Vicarage, Oswestry
1905		Jones, Edward Towyn, B.Sc., (Wales), A.I.C., 17, Bloomsbury-square, W.C.
1871	Trans.	Jones, Edward William Taylor, F.I.C., The Oaklands, and 10, Victoria-street, Wolverhampton
1873	Trans.	Jones, Francis, M.Sc. (Manc.), F.R.S.E., Beaufort House, Alexandra-park, Manchester
1894		‖Jones, George Cecil, A.C.G.I., F.I.C., Stour-villa, Mistley, Essex
1876	Trans.	‖Jones, Henry Chapman, F.I.C., Royal College of Science, South Kensington, S.W.
1893		Jones, Hedley Gordon, F.I.C., 32, Beechhill-road, Eltham, S.E.
1900	Trans.	Jones, Humphrey Owen, M.A. (Cantab.), D.Sc. (Lond. and Wales), Clare College, Cambridge
1878		Jones, Henry Williams, Spencer-park, Coventry
1904		Jones, Horace Francis, Silchester Villa, London-road, Wokingham, Berks.
1890		Jones, John Archyll, B.Sc. (Lond.), Reethville, Park-road, West Hartlepool
1901		Jones, John Lloyd Thomas, Major, I.M.S., M.B. (Dun.), M.R.C.S. (Eng.), D.P.H. (Cantab.), His Majesty's Assay Office, Calcutta, India
1892	Trans.	Jones, Lionel Manfred, B.Sc. (Lond.), Municipal Technical School, Suffolk-street, Birmingham
1899		Jones, Lauder William, A.B. (Williams Coll.), Ph.D. (Chicago), University of Chicago, Chicago, Ill., U.S.A.
1906		Jones, Llewelyn Thomas, B.Sc. (Wales), 22, Ashfield-terrace, Bingley, Yorks.
1891		Jones, Moses William, Greystonedale, Kensington-hill, Brislington, Bristol
1905		Jones, Percy Walter, A.I.C., Toowong, Brisbane, Queensland
1896		Jones, Robert Haslewood, 88, Norwood-road, S.E.
1901		Jones, Robert Henry, M.Sc. (Vict.), The Harris Institute, Preston
1898		Jones, Thomas Hill-, Invicta Mills, Bow-common-lane, E.
1905		Jones, Tudor Foulkes, B.Sc. (Wales), Chatham House, Ramsgate

Date of Election.			
1904			Jones, William App., A.M. (North Carolina), Ph.D. (Baltimore), c/o The Boston Artificial Leather Co., Metropolitan Building, New York, U.S.A.
1906			Jones, William Henry Matthews, Leyden Villa, Chester
1904	Trans.		Joseph, Alfred Francis, A.R.C.S., Royal College, Colombo, Ceylon
1893	Trans.	C. 1906-	Jowett, Hooper Albert Dickinson, D.Sc. (Lond.), Wansfell, Church-avenue, Sidcup, Kent
1891			Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900			Joyce, Thomas Goode, B.Sc. (Lond.), F.I.C., 41, Britannia-row, Islington, N.
1893			Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.		Kawakita, Michitada, Engineering College, Tokio, Japan
1905	Trans.		Kay, Sydney Alexander, D.Sc. (St. Andrews), United College, St. Andrews, N.B.
1881	Trans.		Kay, William Edward, Marple Lodge, Marple, Cheshire
1889			Kaye, James Robert, M.B. and C.M. (Glas.), D.P.H. (Cantab.), Medical Officer of Health, West Riding of Yorkshire, Wakefield
1886	Trans.	C. 1903-5	‖Keane, Charles Alexander, Ph.D. (Erlangen), M.Sc. (Vict.), F.I.C., The Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1882			‖Keen, Austin, Hon. M.A. (Cantab.), Cefn Llys, Bentley-road, Cambridge
1894			‖Kellas, Alexander Mitchell, B.Sc. (Lond.), 2, St. Mark's-square, Regent's Park, N.W.; and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874			Kellner, William, Ph.D. (Göttingen), F.I.C., 135, Victoria-road, Old Charlton, S.O., Kent
1867			‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882			‖Kemp, William Joel, F.I.C., Caerthillian, Sidcup, Kent
1903			Kemp-Welch, Maurice, B.A. (Cantab.), Parkstone, Weybridge, Surrey
1884			Kendall, George Frederic, B.A. (Cantab.), The Hollies, Stratford-on-Avon
1874			Kendall, James Alfred, F.I.C., Lonesome Chemical Works, Streatham Common, S.W.
1896			‖Kennicott, Cass Langdon, Chicago Heights, Illinois, U.S.A.
1903			Kent, Thomas Oliver, 42, Loughboro'-park, Brixton, S.W.
1889			Kenwood, Henry Richard, M.B. and C.M. (Edin.), L.R.C.P. (Lond.), Wadhurst, 150, Bethune-road, Stamford Hill, N.
1895			Kenyon, Richard Ernest, M.Sc. (Vict.), 3, Fairfield-road, Latchford, near Warrington Lancs.

Date of Election.			
1903			Kerr, James Stewart, A.R.C.S., F.I.C., Methodist College, Belfast
1883			Kerry, William Hugh Rubens, The Sycamores, Windermere
1900			Kershaw, James Henry, Corporation Sewage Works, Dalton, Rotherham, Yorks.
1901			Kettle, James David, B.Sc. (Lond.), A.I.C., 1, Vardens-road, St. John's-hill, Battersea, S.W.
1902			Kewley, James, B.A. (Cantab.), c/o Nederlandsch Indische, Industrié en Handel Maatschappij, Balek Pappin, Dutch Borneo
1901			Kiddell, Christopher George, B.A. (Lond.), Hadley Highstone, Barnet, Herts.
1903			Kielty, John Joseph, Nethersgate, Cairo-road, Walthamstow, Essex
1905			Killby, Leonard Gibbes, B.A. (Oxon.), 10, Aberdeen-park, Highbury, N.
1900			Kilner, George Washington, M.A. (Lond.), 4, Melrose-villas, Church-end, Finchley, N.
1884			Kilpatrick, William Stirling, Hawklin, Stuart-drive, Colston, near Bishopbriggs
1903			Kin, Thein, B.A. (Calcutta), Chemical Examiner's Office, Rangoon, Lower Burma, India
1872	Trans.	C. 1887-92	‖Kinch, Edward, Prof., F.I.C., Royal Agricultural College, Cirencester
1907			King, Albert Theodore, B.Sc. (Lond.), A.I.C., Church-hill, Horsell, Woking, Surrey
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1902			‖King, Frank Eustace, B.Sc. (Lond.), A.I.C., Woodbury, Polworth-road, Streatham, S.W.
1903			King, Frank William George, 15, Almond-road, Tottenham, N.
1897			King, Herbert, M.Sc. (Vict.), F.I.C., 8, Avenue-road, Scarborough
1876			King, John Falconer, F.I.C., Laboratory of City Analyst, 20, Chambers-street, Edinburgh
1902			King, Sidney Isaac, 1, Russell-villas, Strawberry Hill, Middlesex
1895			Kingdon, George Holman, M.A. (Oxon.), c/o Messrs. Crosfield, Limited, Warrington; and Ivy Lodge, Froghall, Warrington
1872	Trans.		‖Kingzett, Charles Thomas, F.I.C., 1, Hornton-street, Kensington, W.
1895			‖Kinnicut, Leonard Parker, Prof., Sc.D. (Harvard), Worcester Polytechnic Institute, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	‖Kipping, Frederic Stanley, Prof., D.Sc. (Lond.), Ph.D. (Munich), F.R.S., F.I.C., University College, Nottingham
1886			Kirby, Herbert Edward, 41, Gordon-square, W.C.
1890			Kirk, Oliver, The Meads, Bramhall-lane, Bramhall, Cheshire

Date of Election.		
1895		‖Kirkaldy, Patrick Henry, F.I.C., Chemical Department, King's College, W.C.
1903		Kirkby, William, Winster House, Thornfield-road, Heaton Moor, Stockport
1889		Kitchin, John, The Middlesex Hospital, W.C.
1888		‖Knaggs, Alfred Battye, 37, Mannville-terrace, Bradford
1889		Knight, Frederick Charles, c/o Garfield Smelting Co., Garfield Utah, U.S.A.
1903		Knight, Harley Fancut, Ledbury, 64, Amhurst-park, Stamford Hill, N.
1894		Knight, James, M.A., D.Sc. (Glas.), St. James's Public School, Calton, Glasgow
1896		Knight, John Burnett, Bushwood, Wanstead, Essex
1894		Knight, William Albert, Sexey's Trade School, Bruton, Somerset
1878		Knights, James West, F.I.C., County Laboratory, Cambridge
1879		Knowles, Joshua, Stormer-hill, Tottington, Bury
1864		Knox, George Walter, B.Sc. (Lond.), 16, Finsbury-circus, E.C.
1873		Koch, Walter Edward, M.A., P.O. Box 718, El Paso, Texas, U.S.A.
1887	Trans.	Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1904		Komppa, Gustav, Prof., Ph.D., Polytechnik, Helsingfors, Finland
1885		Koningh, Leonard de, F.I.C., 4, St. Martin's-road, Stockwell, S.W.
1892		Krause, Georg, Prof. Dr., Cöthen (Anhalt), Germany
1859	Trans.	Kynaston, Josiah Wyckliffe, F.I.C., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900		Kynaston, William Charles Robert, 9, Harland-road, Higher Tranmere, Birkenhead
1906		Ladell, William Richard Simpson, 19, Alwyne-road, N.
1893		Lamb, Edmund George, M.A. (Oxon.), M.P., Borden Wood, Liphook, Hants.
1900		Lamb, Morris Charles, Herold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.	‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893		Lambert, Wesley J., Chemical Laboratory, Royal Gun Factory, Woolwich, S.E.
1903	Proc.	Lamplough, Francis Edward Everard, B.A. (Cantab.), Trinity College, Cambridge
1877		Lancaster, William James, F.R.C.S., Pine Crest, Barnt Green, Worcs.
1902		Landau, A. Lionel, Taquah and Abosso Gold Mining Co., Ltd., Tarquah, Gold Coast, W. Africa

Date of Election.			
1900	Trans.		Lander, George Druce, D.Sc. (Lond. and St. Andrews), F.I.C., Royal Veterinary College, Camden Town, N.W.
1897	Trans.		Lang, William Robert, Prof., D.Sc. (Glas.), F.I.C., The University, Toronto, Canada
1899			Lange, Ernest Frederick Stephen, Fairholm, Willow Bank, Fallowfield, Manchester
1885			Langer, Charles, Ph.D. (Zürich), Ynyspenllwch, Clydach, S.O., Glamorgan
1891			‖Langham, Edgar Norman, Rev., M.A. (Cantab.), Rastrick Grammar School, Brighouse
1894	Trans.	C. 1904-7	Lapworth, Arthur, D.Sc. (Lond.), F.I.C., The Goldsmiths' Institute, New Cross, S.E.
1901	Proc.		Larter, Alfred Tabois, B.Sc. (Lond.), 86, Inderwick-road, N.
1883			Lascelles, Brian Piers, M.A. (Oxon.), Longridge, High-street, Harrow-on-the-Hill
1880			Last, Frank Bernard, F.I.C., Maes-y-Mor, Eaton-grove, Swansea
1901			Lattey, Robert Tabor, Trinity College, Oxford
1906			Lattey, William Tabor, Corpus Christi College, Cambridge
1891	Trans.		Lauder, Alexander, D.Sc. (Edin.), Edinburgh and East of Scotland College of Agriculture, 13, George-square, Edinburgh
1904			Lauder, James Stanley, Contra Costa Co., c/o Post Office, Martinez, Cal., U.S.A.
1886	Trans.		Laurie, Arthur Pillans, Principal, M.A. (Cantab.), D.Sc. (Edin.), F.R.S.E., The Heriot-Watt College, Edinburgh
1876			‖Law, Channell, Ilsham Dene, Torquay
1905	Trans.		Law, Herbert Drake, B.Sc. (Lond.), Borough Polytechnic, 103, Borough-road, S.E.
1896			‖Law, Herbert Edward, Fairmont-building, San Francisco, Cal., U.S.A.
1890	Trans.		‖Law, Robert, F.I.C., The Royal Mint, Melbourne, Australia
1903			Lawrence, Henry William, Johnsonville, Wellington, New Zealand
1900			Laws, Arthur Robert, B.Sc., (Lond.), 90, St. George's-terrace, Newcastle-on-Tyne
1882			Laws, Joseph Parry, F.I.C., 2, Aigburth-vale, Liverpool
1890	Trans.		‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890			Lea, Arthur Sheridan, M.A., Sc.D. (Cantab.), F.R.S., Sunnyside, Sidcup, S.O., Kent
1886			‖Leach, Walter, 21, St. Andrew's-place, Bradford
1902			Leader, George Herbert, Montego Bay Secondary School, Montego Bay, Jamaica
1894	Trans.		‖Lean, Bevan, B.A., D.Sc. (Lond.), Sidcot School, Winscombe, Somerset

Date of Election.			
1888			Lease, Frank Edward, Sapong Estate, Fort Birch, British North Borneo
1902			Leather, John Petty, Whittier, Colne-road, Burnley, Lancs.
1891	Trans.		Leather, John Walter, Ph.D. (Freiburg), F.I.C., Agricultural Research Institute, Pusa, Bengal, India
1900			‖Leathes, John Beresford, M.A., M.B. and B.Ch. (Oxon.), F.R.C.S. (Eng.), 89, Albert Bridge-road, S.W.
1889			Ledingham, Laurence Napier, Govandale, Taptonville-crescent, Sheffield
1883			Lee, Herbert Cabry, Flat 20, 36, Buckingham Gate, S.W.
1898			Lee, Harry Lancelot, 32, Manor Drive, Headingley, Leeds
1897	Trans.		Lee, Theophilus Henry, 36, Rua do Ouvidor, Rio de Janeiro, Brazil
1891			Leeds, Frank Henley, F.I.C., West Allington, Bridport
1905			Leek, William Henry, B.A. (Lond.), Elm View, Leigh, Lancs.
1899			Leeming, William Thomas, M.Sc. (Vict.), The Hollins, Hanover-road, Canterbury
1873			Lees, Charles, Oakland House, Holywell, N. Wales
1903	Trans.		Lees, Frederic Herbert, Avondale, Green-street-green-road, Dartford, Kent
1891			Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889			‖Legg, John Edmund, M.A. (Cantab.), F.I.C., Cae Rhys, Dorchester-road, Weymouth
1901			Lehmann, Adolf Ludwig Ferdinand, B.Sc. (Toronto), Ph.D. (Leipzig), Bangalore, Mysore, India
1891	Proc.		Leicester, James, Ph.D. (Erlangen), F.I.C., 17, Staverton-road, Oxford
1903			Leigh, Arthur Graham, jun., Chorcliff House, Chorley, Lancs.
1889			Leigh, Cecil, F.I.C., Birmingham Metal and Munitions Co., Ltd., Adderley Park Rolling Mills, Birmingham
1904			Le May, Percy Kent, 6, Lothair-villas, Hatfield, Herts.
1891			Lennox, Robert N., Morvah, Hartington-road, Chiswick, S.W.
1899			Leon, Arthur Alexander, Ray House, Ray-park-road, Maidenhead
1906	Trans.		Le Rossignol, Robert, B.Sc. (Lond.), A.I.C., 2, Caesarea-place, Jersey, Channel Islands
1904			Lessing, Rudolf, Ph.D. (Munich), Clydach, S.O., Glamorgan
1902			Lessner, Charles B., Carril, Spain
1895	Trans.	C. 1907.	‖Le Sueur, Henry Rondel, D.Sc. (Lond.), F.I.C., St. Thomas's Hospital, S.E.
1896	Trans.		Lethbridge, William Arthur Finch, B.A. (Oxon.), Moore's Hotel, Cork, Ireland
1899			Lett, Stephen Joshua, Tete, Zambesi River, Africa

Date of Election.			
1879			Letts, Edmund Albert, Prof., Hon. D.Sc. (R.U.I.), Ph.D. (Göttingen), F.I.C., Queen's College, Belfast
1904			Levy, Arthur Garfield, B.Sc. (Lond.), F.I.C., c/o B. Blount, Esq., F.I.C., 76, York-street, Westminster, S.W.
1903			Levy, Henry Wolff, 423B, Little Collins-street, Melbourne, Australia
1888	Trans.		Lewes, Vivian Byam, Prof., F.I.C., 19, Park-row, Greenwich, S.E.
1907			Lewis, Carl, P.O. Box 36, Johannesburg, S. Africa
1899	Trans.		Lewis, Edward Watkin, Hollycroft, Loughton, Essex
1901			Lewis, Ernest Alfred, 310, Dudley-road, Birmingham
1905			Lewis, Ernest Isaac, B.A. (Cantab.), B.Sc. (Lond.), Oundle School, Oundle
1894	Trans.		Lewis, William Henry, M.A. (Oxon.), F.I.C., 24, Wonford-road, Exeter
1869	Trans.		‖Lewis, William James, M.A. (Oxon. and Cantab.), Prof., New Museums, Cambridge
1888	Trans.	C. 1902–03	‖Lewkowitsch, Julius, M.A. and Ph.D. (Breslau), F.I.C., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, Theodore David, F.I.C., Chemical Works, Silvertown, E.
1896			Lidgey, Cecil Rudolf, 50a, Forest Hill-road, East Dulwich, S.E.
1900			Liebmann, Adolf, M.A., Ph.D. (Bonn), 16, Darley-avenue, West Didsbury, Manchester
1903			Linday, John Howard, c/o Messrs. John Robinson and Co., Ltd., Oil Seed Crushers, Redcliffe-parade, Bristol
1901			Linde, Harold Theodor Granville van der, 101, Tyndall-avenue, Toronto, Canada
1892			Lindley, Hubert Edward, Rosemount, Pinner-road, Harrow
1899			Lindsey, Robert William, 14, Hilldrop-road, Camden-road, N.
1886	Trans.		Ling, Arthur Robert, F.I.C., 74, Great Tower-street, E.C.
1899			Linstead, Edward Flatman, 15, Station-avenue, Winchmore Hill, N.
1902			Liotard, Ernest, 2, Rue de France, Nice, France
1905			Lister, Joseph, B.Sc. (Lond.), A.R.C.S., 50, Portland-street, Lancaster
1853	Trans.	V.P. 1883-7, 1898-1901.	‖Liveing, George Downing, Prof., M.A. (Cantab.), Hon. Sc.D. (Dub.), F.R.S., F.I.C., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof. M.A. (Cantab.), Hon. LL.D. (Glas.), A.R.S.M., F.R.S., F.I.C., The University, Sydney; and The Octagon, St. Mark's-road, Darling Point, Sydney, N.S.W.
1903			Livesey, Charles Edwin Leonard, B.Sc. (Vict.), Stonyhurst College, Blackburn, Lancs.
1883			Livingston, William John, F.I.C., London County Council, Spring-gardens, S.W.

Date of Election.		
1880		‖Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.	Lloyd, Frederick James, F.I.C., Muscovy House, 6, Trinity-square, E.C.
1905		Lloyd, George Moss, M.A. (Vict.), M.Sc. (L'pool), 43, Elmwood-road, Herne Hill, S.E.
1907		Lloyd, Percival George, 15, Woodside-road, Kingston-on-Thames
1896		Lloyd, Thomas Henry, c/o Messrs. Quibell Bros., Ltd., Newark-on-Trent
1900		Lockhart, Thomas Lamb, Glencairn Main Reef Gold Mining Co., Ltd., P.O. Box 191, Germiston, Transvaal, S. Africa
1902		Lockitt, Charles Henry, B.A. (Lond.), Rectory Cottage, Solihull, Birmingham
1896		Lockwood, Thomas William, Heckmondwike, Yorks.
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1902		Logan, Thomas Stratford, The Colony, Ewell, Surrey
1884		London, John Edward, M.D. (Dun.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 62, Main-street, Georgetown, Demerara, W. Indies
1872		‖Longstaff, George Blundell, M.A. and M.D. (Oxon.), F.R.C.P., (Lond.), M.R.C.S. (Eng.), Highlands, Putney Heath, S.W.
1904		Longstaff, James Patrick, B.Sc. (Edin.), 17, Fettes-row, Edinburgh
1873		‖Loram, Herbert Yabsley, F.I.C., 49, Buxton-road, Chingford, Essex
1878	Trans.	‖Louis, David Alexander, F.I.C., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward Gurley, Ph.D. (Columbia), 80, East 55th-street, New York, U.S.A.
1882		‖Lovibond, Thomas Watson, F.I.C., West Jesmond House, Newcastle-on-Tyne
1884		‖Low, Charles William, M.B. (Dun.), L.R.C.S. (Eng.), L.R.C.P. (Lond.), Stricklands, Stowmarket, Suffolk
1904	Trans.	Lowe, Frank Harold, M.Sc. (Vict.), South-Western Polytechnic, Manresa-road, Chelsea, S.W.
1878		‖Lowe, Walter Bezant, M.A. (Cantab.), Cae Carw, Llanfairfechan, N. Wales
1876		Lowe, William Foulkes, A.R.S.M., F.I.C., 9, Hough-green, Chester
1898	Trans.	‖Lowry, Thomas Martin, D.Sc. (Lond.), 130, Horseferry-road, Westminster, S.W.
1901		Lowson, William, B.Sc. (Lond. and Leeds), F.I.C., The University, Leeds
1899		Lucas, Alfred, F.I.C., Survey Department, Finance Ministry, Giza, Egypt

Date of Election.		
1905		Lucas, Edward William, F.I.C., 2, Hills-place, Oxford-street, W.
1902		Lucas, Harry, The South of England College of Pharmacy, 186, Clapham-road, S.W.
1905		Luck, Alfred Courtenay, The Arsenal, Zarate, Argentina, S. America
1902	Trans.	Ludlam, Ernest Bowman, Ackworth School, near Pontefract, Yorks.
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, S. Africa ; and Southville, Swansea
1877	Trans.	‖Luff, Arthur Pearson, M.D., B.Sc., F.R.C.P. and L.S.A. (Lond.), M.R.C.S. (Eng.), D.P.H. (Glas.), F.I.C., 9, Queen Anne-street, Cavendish-square, W.
1890	Trans.	Lumsden, John Scott, D.Sc. (St. Andrews), Ph.D. (Munich), 9, Rosewood-terrace, West Park, Dundee
1907		Lunan, George, 50, Garscube-terrace, Murrayfield, Edinburgh
1867	Trans.	‖Lunge, Georg, Prof., Ph.D. (Breslau), Rämisstrasse 56, Zürich, Switzerland
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles Mann, D.Sc. (Lond.), F.I.C., Jumples Lodge, near Halifax, Yorks.
1899		Luxton, Thomas, B.A., B.Sc. (Lond.), 28, Albany-street, Hull
1873		Lyon, Isidore Bernadotte, Brigade Surgeon, Lieut.-Col., C.I.E., M.R.C.S. (Eng.), F.I.C., East India U.S. Club, 16, St. James's-square, S.W. ; and 164, Sutherland-avenue, W.
1874		Lyon, John George, F.I.C., The Aire Tar Works, Knottingley, Yorks.
1905		Lyon, Rudolf, 400, Huddersfield-road, Halifax
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72, Brainard-street, Detroit, Mich., U.S.A.
1888		Maben, Thomas, Kenmure, 63, Stradella-road, Herne Hill, S.E.
1896		Macadam, Herbert Edwin, Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson John Charles George, F.I.C., Analytical Laboratory, 55, York-place, Edinburgh
1899		McAlley, James, c/o Johan Bryde, Esq., Sandefjord, Norway
1900		Macara, Thomas, F.I.C., c/o Messrs. Lipton, Ltd., Rouel-road, Bermondsey, S.E.
1887		‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1890		‖MacArthur, John Stewart, 74, York-street, Glasgow
1888		McBretney, Edmund George, F.I.C., 23, Ferrybridge-road, Castleford, Yorks.
1900		McCall, William, 8, Beaton-road, Maxwell-park, Glasgow

Date of Election.		
1902		MacCallum, Douglas Archibald, Central-chambers, 93, Hope-street, Glasgow
1905		McCleary, William, 61, Station-road, Pendlebury, near Manchester
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1906		McCombie, Hamilton, M.A. (Aberd.), B.Sc. (Lond.), Ph.D. (Strassburg), A.R.C.S., F.I.C., The University, Birmingham
1907	Trans.	McConnan, James, M.Sc. (Vict.), Ph.D. (Jena), Frigorifico, Campana, F.C.R., Argentina, S. America
1904		McCourt, Cyril Douglas, A.C.G.I., 13, Malwood-road, Balham Hill, S.W.
1875		‖McCowan, William, F.I.C., Essex Wharf, Narrow-street, Limehouse, E.
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D. (Heidelberg), F.I.C., Government Laboratories, P.O. Box 1080, Johannesburg, S. Africa
1899		McCreath, William Dunlop, Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater
1890		‖McCubbin, William Alexander, F.I.C., May Cottage, Neston, Cheshire
1897		MacCulloch, Charles, Auckland Club, Auckland, New Zealand
1894		McCutcheon, James, Meniehaus, Woodend-drive, Jordanhill, Glasgow
1903		Macdonald, David Baird, 82, Hinckley-road, Leicester
1901		Macdonald, F. G., Cyanide Manager, Durban Roodeport Gold Mining Co., Ltd., P.O. Box 111, Roodeport, Transvaal, S. Africa
1894	Trans.	MacDonald, George William, M.Sc. (Melbourne), Whitehall Residential Hotel, 70, Guilford-street, Russell-square, W.C.
1901		Macdonald, Peter, c/o The Mazapil Copper Co., Ltd., Concepcion del Oro, Zacatecas, Mexico
1906		Macdonald, Thomas, Emmotland House, North Frodingham, Driffield, Yorks.
1891		MacDonald, William, A.R.C.S., A.R.S.M., F.I.C., Assistant Postal Secretary, Peking, China
1904		McDougall, Arthur Thomas, B.A. (Lond.), 8, Cliff-terrace, St. John's, S.E.
1906		McDowall, John, c/o H. Monson, Esq., Sabaieh, Upper Egypt
1874		McDougall, John, Clifton House, Greenwich Park, S.E.
1906		Mace, William, Kew-gardens, Monkseaton, Northumberland
1886		MacEwan, Peter, 64, Southwood-lane, Highgate, N.
1898		McEwen, Antholl Francis, 40, Handen-road, Lee, S.E.
1895		MacFarlane, Alexander, 40, Albion-road, Fallowfield, Manchester

Date of Election.			
1891			Macfie, Robert Andrew Scott, M.A. (Cantab.), B.Sc. (Edin.), 34, Moorfields, Liverpool
1895			McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.		McGowan, George, Ph.D. (Leipzig), F.I.C., 21, Montpelier-road, Ealing, W.
1893			McGregory, Joseph Frank, Prof., Colgate University, Hamilton, New York, U.S.A.
1906			McIntosh, David, Stamford School, Stamford, Lincs.
1890			Macintyre, Alfred Edgar, Ph.D., The Chemical Laboratory, Dominion Arsenal, Quebec, Canada
1877			‖Mackay, Angus, 121, King-street, Great Yarmouth
1890			Mackean, William, 208, Bedford-hill, Balham, S.W.
1905			MacKechnie, Robert Drysdale, Productos Quimicos de Huelva Sociedad Anonyma, Huelva, Spain
1901	Trans.		McKenzie, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Berlin), Birkbeck College, Bream's Buildings, Chancery-lane, E.C.
1897	Trans.		Mackenzie, John Edwin, D.Sc. (Edin.), Ph.D. (Strassburg), The Technical Institute, Bombay, India
1902			Mackenzie, John Ross, Worcester Brewery, Worcester
1899			Mackenzie, Thomas, 4, Church-street, Inverness
1900			Mackenzie, Thomas Ebenezer, The Capillitas Copper Co., Ltd., Pilciao, Provincia de Catamarca, Argentina, S. America
1893			McKerrow, Charles Alexander, 8, Exchange-street, Manchester
1892			McKerrow, William James, D.Sc. (Tübingen), F.I.C., c/o Messrs. Field and Co., Upper Marsh, Lambeth, S.E.
1897			Maclaurin, James Scott, D.Sc. (N.Z.), Wellington, New Zealand
1868	Trans.	C. 1871-4, 80 4 95-9. V.P. 1887-90, 1901-04	‖McLeod, Herbert, Prof., F.R.S., 37, Montague-road, Richmond, Surrey
1899			McLeod, James, F.I.C., Gas Works, Kirkintilloch, N.B.
1903			MacMahon, Frederick William, 31, Marler-road, Forest Hill, S.E.
1879			‖Macmillan, James Laker, 98, Phillip-street, Sydney, N.S.W.
1897			Macmullen, Alan, B.A. (Oxon.), The Manor House, Raheny, S.O., Co. Dublin
1881			MacMunn, Charles Alexander, M.A. and M.D. (Dub.), L.R.C.S. (Ireland), Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, c/o Maoriland Copper Co., Ltd., Richmond, Nelson, New Zealand
1880			Macnab, William, F.I.C., 10, Cromwell-crescent, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D. (Würzburg), B.Sc. (Lond.), 67, Braid-avenue, Edinburgh
1905			Maguire, Peter, 199, Piccadilly, W.

Date of Election.			
1899			Main, Hugh, B.Sc. (Lond.), Almondale, Buckingham-road, South Woodford, N.E.
1900			Mair, William, 7, Comiston-road, Edinburgh
1902	Trans.		Maitland, William, B.Sc. (Aberd.), Auchmill, Bucksburn, Aberdeenshire
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1906			Majumdar, Tarak Nath, 37, Lower Chitpore-road, Calcutta, India
1894			Makin, Charles James Shaw, F.I.C., Thorn Bank, Leamington
1885	Trans.		‖Mallet, Frederic Richard, F.I.C., 20, King's-avenue, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, John William, Prof., Ph.D. (Göttingen), M.D. (Louisiana), LL.D. (Princetown, Pennsylvania, and Johns Hopkins Univ.), F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, Willie Lee, Gawthorp-green, Kirkheaton, near Huddersfield
1904			Mander, Alfred, Berkswell, Malvern
1903			Mander, Percy George, B.Sc. (Lond.), The Grammar School, Doncaster
1903			Mann, Ernest William, Lyndale, Northfield-road, King's Norton, Birmingham
1903			Mann, John Christopher, 9, Lambert-street, Hull
1902			Mann, William, B.Sc. (Lond.), 68, Breakspears-road, Brockley, S.E.
1896			Manners, Hugh, M.A., B.Sc. (Glas.), Academy House, Airdrie, N.B.
1897			Mansford, Charles John Jodrell, B.A. (Lond.), The Grammar School, Dartford, Kent
1895			‖Marchant, Robert Charles, The Glen, 11, Elliston-road, Redland, Bristol
1896			Marks, Edward Seaborn, c/o David Marks, Esq., 23, Palace Gate, S.W.
1905			Marle, Ernest Robert, B.Sc. (Lond.), A.R.C.S., 135, Le Marchant-road, St. John's, Newfoundland
1895			Marsden, Prosper Henry, The Royal Infirmary, Liverpool
1902			Marsh, John, 29, High-street, Maidstone
1883	Trans.	C. 1902-7	‖Marsh, James Ernest, M.A. (Oxon.), F.R.S., University Museum, Oxford
1895	Trans.		Marshall, Arthur, F.I.C., The Cottage, Dartford, Kent
1890	Trans.		Marshall, Hugh, D.Sc. (Edin.), F.R.S., 12, Lonsdale-terrace, Edinburgh
1896			Marshall, Percy Sykes, Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, 57, Maplethorp-road, Thornton Heath, Surrey.

Date of Election.			
1887			‖Marshall, William, F.I.C., Carisbrook, Queen's-road, Cheadle Hulme, Cheshire
1897			Martin, Charles Henry, 40, Bolton-road, Pendleton, Salford
1902			Martin, Francis, 3, York-terrace, Eglinton-road, Plumstead, S.E.
1904			Martin, Francis Grimshaw, 1, Harbury-road, Birmingham
1906			Martin, Frederick James, Passagem de Mariana, Minas, Brazil
1906			Martin, George Frederick Wesley, 14, Castle-park, Lancaster
1898	Trans.		‖Martin, George Herbert, M.A. (Oxon.), 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Gerald Ward, Lieut.-Col., 8, Petersham-terrace, Gloucester-road, S.W.
1905			Martin, Harry, c/o Messrs. Burroughs, Wellcome and Co , 45, Lafayette-street, New York, U.S.A.
1907			Martin, Joseph, B.Sc. (Dun.), 37, Fairlop-road, Leytonstone, E.
1901			Martin, Nicholas Henry, Ravenswood, Low Fell, Gateshead-on-Tyne
1902			Martindale, William Harrison, Ph.D., 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C.; and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Streatham-grove, Norwood, S.E.
1898			Mascarenhas, John Charles, 142, Weston-park, Crouch End, N.
1851	Trans.	C. 1858-9, 75-7 V.P. 78-81	Maskelyne, Mervyn Herbert Nevil Story, M.A., Hon. D.Sc. (Oxon.), F.R.S., F.I.C., Salthrop, Wroughton, Wilts.
1905			Mason, Arthur Walter, B.Sc. (Lond.), Norvic, Windsor-gardens, North Shields
1890			Mason, Francis Herbert, c/o The Johnson Graham Mining Co., Plumas Eureka Mines, Johnsville, Cal., U.S.A.
1882	Trans.		Masson, David Orme, Prof., M.A., and D.Sc. (Edin.), F.R.S., The University, Melbourne, Australia
1897			Masters, Edward, Rock Mount, 186, Hinckley-road, Leicester
1873			‖Masters, William, St. Erme, The Hall-road, Cheltenham
1906			Martin, John, Woodleigh House, Totley Brook, near Sheffield
1904			Mathews, Harold Joseph Clarke, Massey's Burnley Brewery, Ltd., Burnley, Lancs.
1896			Mathieson, Laurence Weir, Conway, Rosebery-road, Gillingham, S.O., Kent
1902			Mathieson, Robert, J.P., Rill Bank, Innerleithen, Peeblesshire
1876	Trans.		‖Matthews, Charles George, F.I.C., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1907			Matthews, Charles Pask, B.Sc. (Lond.), 6, Fortess-road, N.W.
1880	Trans.	C. 1906-	‖Matthews, Francis Edward, Ph.D. (Göttingen), F.I.C., 6, Hillcroft-crescent, Ealing, W.

Date of Election.			
1884			‖Matthey, Edward, Col., C.B., A.R.S.M., 31a, Weymouth-street, W.
1870		C. 1877-9	Matthey, George, Assoc.Inst.C.E., F.R.S., 78, Hatton-garden, E.C.
1905			Maughan, Reginald Bruce, P.O. Box 46, Bundaberg, Queensland
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. (Cantab.), F.R.C.S. (Edin.), B.Sc. (Lond.), 29, Woolwich Common, S.E.
1892			Meacham, Charles Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, S. Africa
1898			Meads, Charles James, Bel Air, Dartmouth, Devon
1904			Mears, Francis D'Oyley, jun., 47, Despenser-street, Cardiff
1901	Trans.		Mees, Charles Edward Kenneth, D.Sc. (Lond.), 76, Canterbury-road, Croydon
1896			Meggitt, Loxley, F.I.C., c/o C.W.S., Ltd., Wheatsheaf Works, Alexandria, Sydney, N.S.W.
1871	Trans.	C. 1883-7, 90-91 F.S. 1891-1902 V.P. 1902-05 P. 1905-7	‖Meldola, Raphael, Prof., F.R.S., F.I.C., Finsbury Technical College, Leonard-street, E.C.; and 6, Brunswick-square, W.C.
1905	Trans.		Meldrum, Andrew Norman, D.Sc. (Aberd.), 16, Mooroaks-road, Sheffield
1895			Meldrum, Robert, Glynwood, 37, Foyle-road, Blackheath, S.E.
1894			Melland, Godfrey, M.Sc. (Vict.), A.R.S.M., F.I.C., Chemical Department, The Polytechnic, Woolwich, S.E.
1902	Trans.		Mellor, Joseph William, D.Sc. (N.Z.), West View, near Longport Station, Wolstanton, Staffs.
1875			‖Melmore, Pattinson Banks, Chemical Laboratory, Maryport
1902			Mence, George Augustus Henry, B.Sc., The Grammar School, Lincoln
1900	Proc.		Menzies, Alan Wilfrid Cranbrook, Prof., M.A. and B.Sc. (Edin.), St. Mungo's College, Castle-street, Glasgow
1889			Mercer, Thomas, F.I.C., The Lion Brewery, Eastbourne
1901			Meredith, William, 63, Albion-place, Ulverston, Lancs.
1896			Merrett, William Henry, A.R.S.M., F.I.C., Hatherley, Grosvenor-road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland-park, Sheffield
1897			Merson, George Fowlie, 7, King-street, Kilmarnock, N.B.
1876	Trans.	C. 1884-8, 1897-1901 V.P. 1906-	‖Messel, Rudolph, Ph.D. (Tübingen), 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans, Ph.D., 1, Salmgasse, Prague, Bohemia

Date of Election.			
1905			Micklewright, Harry George Fletcher, B.A. (Oxon.), 116, St. James'-road, Croydon
1904			Middleditch, Bernard, B.A. (Cantab.), Woodcroft, Harrow-on-the-Hill
1906			Middleton, Alexander Edmund, 112, South-park-road, Wimbledon, S.W.
1888	Trans.	V.P. 1901-04	‖Miers, Henry Alexander, Prof., M.A., D.Sc. (Oxon.), F.R.S., Magdalen College, Oxford
1904			Millar, Ernest Westby, Windsor, Monkstown, Co. Dublin.
1892	Trans.		Millar, James Hill, F.I.C., 2, Kerrymount-avenue, Foxrock, Co. Dublin
1891			‖Millard, Edgar James, 35–42, Charlotte-street, Great Eastern-street, E.C.
1905			Millen, John Dunlop, Mount Bischoff Mine, Waratah, Tasmania
1880	Trans.		‖Miller, Alexander Kenneth, Ph.D. (Würzburg), F.I.C., Kilvert's-buildings, Withy Grove, Manchester
1902			Miller, Edward Holl, 81, Chardmore-road, Stoke Newington, N.
1889			Miller, Harry East, Ph.D. (Strassburg), 1015, Chestnut-street, Oakland, California, U.S.A.
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc. (Illinois), Ph.D. (Berlin), 44 & 45, Lewis Block, Buffalo, N.Y., U.S.A.
1885	Trans.		‖Miller, Norman Harry John, Ph.D. (Würzburg), F.I.C., Harpenden, Herts.
1898			Miller, William Lash, B.A. (Toronto), Ph.D. (Munich), 50, St. Alban-street, Toronto, Canada
1896			Miller, William Murray, Caledonia Estate, Province Wellesley, Penang, Straits Settlements
1902	Proc.		Millington, John Price, B.A. (Cantab.), B.Sc. (Wales), Royal Societies' Club, St. James's-street, S.W.
1893	Trans.		‖Mills, Charles, F.I.C., P.O. Box 112, Kroonstad, S. Africa
1862	Trans.	C. 1868-72, 75-6, 80-4, 1903-06	‖Mills, Edmund James, Prof., D.Sc. (Lond.), LL.D. (Glas.), F.R.S., F.I.C., 64, Twyford-avenue, West Acton, W.
1906			Mills, Herbert Arthur, 3, Croxted-road, West Dulwich, S.E.
1898	Trans.		Mills, William Hobson, M.A. (Cantab.), Sc.D. (Tübingen), The Northern Polytechnic Institute, Holloway, N.
1905	Trans.		Mills, William Sloan, M.A., D.Sc. and B.E. (R.U.I.), Chemical Dept., The Polytechnic, Woolwich, S.E.
1885			‖Milne, Alexander, Lieut.-Col. I.M.S., M.A., M.B. and M.Ch. (Aberd.), H.M.'s Mint, Bombay, India
1887			Mingaye, John Charles Henderson, F.I.C., Department of Mines, Assay Branch, Sydney, N.S.W.

Date of Election.			
1898			‖Mitchell, Albert Henry, B.Sc. (Lond.), F.I.C., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1907	Trans.		Mitchell, Herbert Victor, 26, Brookfield-avenue, Walthamstow, N.E.
1905			‖Modi, Edalji Manekji, D.Sc. (N. Carolina), LL.D. (Tennessee), Litt.D. (Providence, Ohio), Opposite Grant-road-station, Sleater-road, Bombay, India
1899			Mohr, Bernard, Ph.D. (Heidelberg), 69A, Parliament-hill, Hampstead, N.W.
1901	Trans.		Moir, James, M.A., D.Sc. (Aberd.), Chemical Laboratory, Mines Department, Winchester House, Johannesburg, S. Africa
1893			Mole, Herbert Bloome, The Croft, Shepton Mallet
1902			Molesworth, Francis Hylton, Jersey-road, Artarmon, Sydney, N.S.W.
1899			Molson, John Cavendish, M.D. (Chicago), L.R.C.P. (Lond.), 1, Pavilion-buildings, Brighton
1899			Mond, Emile Schweich, 22, Hyde-park-square, W.
1872	Trans.	C. 1885-6 V.P. 87- 90, 94-8	‖Mond, Ludwig, Hon. D.Sc. (Vict. and Oxon.), Hon. Ph.D. (Heidelberg), F.R.S., F.I.C., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A. (Cantab.), F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1879			‖Mondy, Edmund Felix, A.R.S.M., Dacca, 96, Huron-road, Balham, S.W.
1903	Trans.		Monier-Williams, Gordon Wickham, M.A. (Oxon.), Ph.D. (Freiburg), A.I.C., The Lammas, Esher, Surrey
1904			Montgomery, Jack Percival, Ph.D. (Virginia), A.M. (Clarksville), Agricultural College, Starkville, Miss., U.S.A.
1887	Trans.	C. 1899- 1900 1905-	‖Moody, Gerald Tattersall, D.Sc. (Lond.), F.I.C., Lorne House, North Dulwich, S.E.
1897			Moon, Philip George Gregory, Hillcroft, Alexandra-road, Upper Parkstone, Dorset
1892			‖Moor, Cresacre George, M.A. (Cantab.), F.I.C., Savoy House, 115, Strand, W.C.
1903			Moore, Alfred Ernest, B.A., B.Sc. (Lond.), Escuela Normal Regional, Corrientes, Argentina, S. America
1903			Moore, Arthur, 109, Elgin-road, Seven Kings, Essex
1905	Trans.		Moore, Charles Watson, B.Sc. (Vict.), 38, Demesne-road, Whalley Range, Manchester
1891			Moore, Frederick Herbert, 39, Lime-street, E.C.
1902			Moore, Thomas Henry, c/o Messrs. Burroughs, Wellcome & Co., 45, Lafayette-street, New York, U.S.A.
1904	Trans.		Moore, Tom Sidney, M.A. (Oxon.), B.Sc. (Lond.), Magdalen College, Oxford
1895			Morgan, David James, M.A., M.D. and B.C. (Cantab.), D.P.H. (Lond.), The Cancer Hospital, Fulham-road, S.W.

Date of Election.			
1897			Morgan, Frederick Filmer de, 19A, Firs Mansions, Fortis-green-road, Muswell Hill, N.
1898	Trans.		‖Morgan, Gilbert Thomas, D.Sc. (Lond.), A.R.C.S., F.I.C., Royal College of Science, South Kensington, S.W.; and 15, Fawcett-street, Redcliffe-gardens, S.W.
1888			‖Morgan, John James, F.I.C., The Laboratory, Messrs. Cammell, Laird and Co., Ltd., Workington, Cumberland
1900			Morgan, John Livingston Rutgers, Prof., A.M., Ph.D. (Leipzig), B.Sc., Columbia University, New York, U.S.A.
1880	Trans.		Moritz, Edward Ralph, Ph.D. (Göttingen), F.I.C., 45, Great Tower-street, E.C.
1879	Trans.	C.1887-90, 96-1900.	‖Morley, Henry Forster, M.A., D.Sc. (Lond.), F.I.C., 5, Lyndhurst-road, South Hampstead, N.W.
1895	Trans.		‖Morrell, Robert Selby, M.A. (Cantab.), Ph.D. (Würzburg), c/o Messrs. Mander Bros., Wolverhampton; and South Bank, Compton, Wolverhampton
1892			Morris, Albert, B.A., B.Sc. (Lond.), Fern Bank, Ashton-under-Lyne
1906			Morris, Arthur Higgs, 27, Hartington-road, Bolton, Lancs.
1900			Morris, Edgar Ford, M.A. (Oxon.), c/o Cornbrook Chemical Co., Ltd., Newbridge Mills, Stockport, Cheshire
1905			Morris, Eric Haydn, 44, Rua Nova de Fransisco de Paula 4, Pampulha, Lisbon, Portugal
1905			Morris, Edwin, A.R.C.S., A.R.S.M., 12, Dragon-view, Harrogate
1891			Morris, Joseph, Ph.D., Fern Bank, 8, Boardman-street, Eccles, Manchester
1851			Morson, Thomas, c/o Messrs. T. Morson and Son, Chemical Works, Ponders End, N.
1905			Mortimer, Alfred, B.A. (Oxon.), The Grammar School, Faversham, Kent
1872			Morton, Edward Handfield, 88, Wigmore-street, W.
1893			Morton, Frederick, Chemical Works, Milnsbridge, Huddersfield
1890	Trans.		Mosenthal, Henry de, F.I.C., 220, Winchester-house, Old Broad-street, E.C.
1896			Moss, Francis Ambrose, Kalgurli Gold Mines, Ltd, Kalgoorlie, Western Australia
1871			‖Moss, Richard Jackson, F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, William Edward, 2, Windermere-terrace, Princes-park, Liverpool
1905			Motion, John, c/o Valvoline Oil Co., Edgewater, New Jersey, U.S.A.
1886			Moul, Frank, F.I.C., Aldersgate Chemical Works, Southall
1884			‖Moyle, Robert Edward, M.A. (Oxon.), Heightley, Chudleigh, S. Devon

Date of Election.			
1902			Müller, Christian, 9, Baronsfield-road, East Twickenham, Middlesex
1859	Trans.	C. 1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D. (Göttingen), LL.D. (St. Andrews). F.R.S., 13, Park-square East, Regent's Park, N.W.
1871	Trans.	C. 1890-4	Muir, Matthew Moncrieff Pattison, M.A. (Cantab.), Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc. (Lond.), F.R.S., The Lodge, Shortlands, Kent
1906			Mukerjee, Ram Chandra, Prof., B.A., Maharaja's College, Jaipur, Rajputana, India
1906			Mummery, William Rest, A.I.C., Little Oakley Hall, near Harwich
1893	Proc.		Munby, Alan Edward, M.A. (Cantab.), Royal Societies' Club, St. James'-street, S.W.
1902			Mundey, Alfred Holley, 14, Wrottesley-road, Plumstead, Kent
1876	Trans.		Munro, John May Herbert, D.Sc. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 12, Grosvenor-place, Bath
1888			Munroe, Charles Edward, Prof., George Washington University, Washington, D.C., U.S.A.
1900			Munton, Frederick Thomas, The Oak House, Winsford, Cheshire
1907			Murgatroyd, Louis, 1, Carlton-drive, Heaton, Bradford
1901			Murphy, Albert John, 11, Lyddon-terrace, Leeds
1904			Murray, Benjamin Lindley, A.M. (Columbia), B.S. (Michigan), 19, University-place, New York, U.S.A.
1893			Murray, John Alan, B.Sc. (Edin.), 5, Caergog-terrace; and University College of Wales, Aberystwyth
1894			Murray, John Moore, M.Sc. (Vict.), 11, Winmarleigh-street, Warrington
1906			Murray, Thomas Jenkins, Ph.D. (Leipzig), The University, Birmingham
1890	Trans.		‖Murray, Thomas Smith, D.Sc. (Edin.), 1, Nelson-street, Dundee
1869			‖Muspratt, Edmund Knowles, Hon. LL.D. (L'pool), F.I.C., Seaforth Hall, near Liverpool
1873			‖Muspratt, Sidney Knowles, 9, Church-street, Flint, N. Wales
1896			Muter, Alexander Henry Mitchell, F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1870	Trans.		‖Muter, John, Ph.D. (Rostock), F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.		Myers, William Shields, M.Sc. (N.J.), 12–16, John-street, New York City, U.S.A.
1887			Nagel, David Henry, M.A. (Oxon.), Trinity College, Oxford
1903			Nairne, Urban Orlando Scotchburn, 7, Hawthorne-terrace, Ripple-road, Barking, Essex
1899	Proc.		Nance, John Trengove, M.A. (Oxon.), Ford Hill, Dartmouth

Date of Election.		
1874		‖Napier, Arthur S., Prof., B.Sc., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinandstrasse, Berlin
1893		Napier, John Watson, Corporation Gas Works, Alloa, N.B.
1900	Trans.	Napper, Sidney Scrivener, A.C.G.I., A.I.C., c/o Messrs. S. Cortauld and Co., Ltd., Foleshill-road, Coventry
1898		Nash, Leonard Myddelton, F.I.C., 3, Princess-road, Finsbury, Park, N.
1900		Naylor, Ernest Brooks, M.Sc. (Vict.), A.I.C., 73, Castle-street, Bolton
1906		Naylor, George, 5, Albert-terrace, Promenade, Blackpool
1891		Naylor, William, 3, Garstang-road, Fulwood-park, Preston
1878	Trans.	Naylor, William Arthur Harrison, F.I.C., 38, Southwark-street, S.E.
1899	Trans.	Neale, Harry Ainley, Mission Junction, British Columbia
1898		Neilson, Alexander MacGillivray, Umbilo Post Office, via Durban, Natal, S. Africa
1901		Neumann, Edgar David Maurice, M.A. (Oxon.), Ph.D. (Göttingen), A.I.C., 7 & 8, Idol-lane, E.C.
1878	Trans.	‖Nevile, Ralph Henry Christopher, Wellingore Hall, Lincoln
1871	Trans.	‖Nevill, Edmund Neville, F.I.C., Government Laboratory, Durban, Natal, S. Africa
1890	Trans.	Neville, Francis Henry, M.A. (Cantab.), F.R.S., Sidney College, Cambridge
1905	Trans.	Neville, Henry Allen Dugdale, B.Sc. (Lond.), A.I.C., County Technical Laboratories, Chelmsford
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, M.A. (Oxon.) Balliol College Laboratory, Oxford
1901		Newbould, Herbert Simpson, 15, York-road, Heaton Moor, near Stockport
1864		‖Newlands, Benjamin Edward Reina, F.I.C., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William Peter Reina, 10, Cricklade-avenue, Streatham Hill, S.W.
1889		Newsholme, George Thomas Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, George S., F.I.C., Royal College of Science, South Kensington, S.W.
1906		Newton, Arthur Percival, B.Sc. (Lond.), Ashburton House, Addiscombe, Croydon
1895		Newton, Charles Butterworth, Whitehall-chambers, Carlisle
1883		Newton, William, Ph.D. (Zürich), F.I.C., 39, Mincing-lane, E.C.
1899	Trans.	Nicholls, William Walter Scott, B.Sc. (Lond.), 230, Brockley-road, Brockley, S.E.

Date of Election.			
1870	Trans.		‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., M.R.C.S. (Eng.), L.S.A. (Lond.), D.P.H. (Cantab.), F.I.C., 1, Huskisson-street, Liverpool
1889			Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892			Nickolls, John Bate, The Exchange, Malvern
1883	Trans.		Nicol, William Walker James, M.A., D.Sc. (Edin.), F.I.C., 15, Blacket-place, Edinburgh
1900			Nightingale, Thomas Marginson, B.Sc. (Vict.), 375, Bridgman-street, Bolton
1898			Nightscales, Thomas Arthur, 37, Jalland-street, Hull
1894			Nixon, Alfred, 7, Oak-road, Sale, Manchester
1869			Noble, Sir Andrew, Bart., K.C.B., D.C.L. (Dun.), F.R.S., Jesmond Dene House, Newcastle-on-Tyne
1903	Trans.		Norman, George Marshall, B.Sc. (Lond.), A.R.C.S., A.I.C., 120, Walmersley-road, Bury, Lancs.
1889			Norman, John Thomas, 23, Leadenhall-street, E.C.
1861			Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892			Norris, Charles James, 31, Airedale-avenue, Chiswick, W.
1897	Trans.		North, Barker, Glenholme, Glenholme-road, Manningham, Bradford
1899	Trans.		Northall-Laurie, Dudley, F.I.C., King's College, Strand, W.C.
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, Thomas Herbert, Prof., Ph.D. (Heidelberg), D.Sc. (Hamilton), c/o The John Crerar Library, Chicago, Ill., U.S.A.
1901			Nunn, Arthur William, 57, Crouch-street, Colchester
1907			Nuttall, Walter Harold, F.I.C., 55, Market-street, Watford, Herts.
1904			Oakden, William Edward, 2, Gledhow-terrace, South Kensington, S.W.
1893	Trans.		Oates, William Henry, Broomhall-park, Sheffield
1907			Oberländer, Otto, Ph.D. (Heidelberg), Chamber of Commerce Buildings, Oxford-court, Cannon-street, E.C.
1903			O'Brien, Frederick, M.Sc. (L'pool.), 87, Dongola-road, Horfield, Bristol
1902			O'Connor, Sinnott Valentine, 14, Selskar-street, Wexford
1890			Oddy, Robert Walter, F.I.C., Waterhouse, Toad-lane, Rochdale
1873			‖Odling, Walter, F.I.C., c/o Messrs. Bass and Co., Burton-on-Trent
1848	Trans.	S. 1856-69 V.P. 1869-73 P. 1873-5	Odling, William, Prof., M.A. (Oxon.), M.B. and F.R.C.P. (Lond.), Hon. Ph.D. (Leyden), F.R.S., F.I.C., 15, Norham-gardens, Oxford
1905			‖O'Farrelly, Alfons, M.A. (R.U.I.), 65a, Upper Leeson-street, Dublin

Date of Election.			
1902			Ogilvie, Allan, Levendale, Frodingham-road, Scunthorpe, Doncaster
1901			Oldershaw, William, Strelley, Nottingham
1904			Oldfield, Laurel Cecil Francis, Lincoln College, Oxford
1906			Oliver, Edgar Gale, M.A. (Cantab.), Chigwell School, Essex
1889			O'Mahony, Daniel John, Municipal-buildings, Cork
1901			Oram, Frank, Market-place, Romsey
1890	Trans.		Ormandy, William Reginald, c/o Crossfield's Soap Works, Warrington
1869			‖Orme, Temple A., University College School, Hampstead, N.W.; and 213, Uxbridge-road, W.
1906	Trans.		Ormerod, Ernest, M.Sc. (Vict.), Ph.D. (Bâle), The Oaklands, Rochdale, Lancs.
1872			‖Ormerod, Joseph Arderne, M.D. (Oxon.), M.R.C.S. (Eng.), F.R C.P. (Lond.), The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887			‖Ormiston, Archibald R., Braeholm, Helensburgh; and 213, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, N.S.W.
1881			Orr, John Bryson, Crossacres, Much Woolton, Liverpool
1897	Trans.		‖Orton, Kennedy Joseph Previté, Prof., M.A. (Cantab.), Ph.D. (Heidelberg), F.I.C., Llwyn Eithin; and University College of North Wales, Bangor
1881	Trans.		O'Shea, Lucius Trant, B.Sc., The Cottage, East Cosham, Hants.
1887			Ostersetzer, Julius, F.I.C., c/o Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1883	Trans.		O'Sullivan, James, F.I.C., High Bank, Burton-on-Trent
1899			O'Sullivan, John, 1461, Georgia-street, Vancouver City, British Columbia
1887			‖O'Sullivan, Patrick Thomas, M.D. and B.Ch. (R.U.I.), 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto Christoph Joseph Gerhard Ludwig, Chantry House, Great Grimsby
1887			‖Overend, Frederick Lawrence, B.A. (Oxon.), 74, Rowley-street, Walsall
1906			Oxland, Charles Harold, B.Sc. (Manc.), 37, Waterloo-road, Bedford
1904			Page, William Davidge, 17, Surrey-street, Strand, W.C.
1898	Trans.		Pakes, Walter Charles Cross, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Cantab.), F.I.C., The Government Laboratories, P.O. Box 1080, Johannesburg, S. Africa

Date of Election.		
1884		‖Pallister, John William, B.Sc. (Lond.), 107, Waverley-road, Bradford
1882		Palmer, Alfred Neobard, Ingle Nook, Bersham-road, Wrexham
1906		Palmer, Arthur Charles, B.Sc. (Lond.), 17, Wansbeck-gardens, West Hartlepool
1888		Palmer, Henry John, Banff, Alberta, Canada
1899		Palmer, Thomas Henry, Amalfi, Longueville, Sydney, N.S.W.
1879		Palmer, Sir Walter, Bart., B.Sc. (Lond.), The College, Reading; and 50, Grosvenor-square, W.
1902		Panisset, Sydney Glyde Stephen, 16, Weston-road, Strood, Kent
1899	Trans	Panting, Laurence Christopher, M.A., M.D. and B.Ch. (Oxon.), 45, Lemon-street, Truro
1900		Pardy, Alexander, Central Experiment Farm, Cedara, Natal, S. Africa
1906		Parfitt, Samuel, 33, Partridge-road, Cardiff
1898		Parker, Alfred James, Salisbury House, Frant-road, Croydon
1897		Parker, Charles Henry, Merrills House, March End, Wednesfield
1882		Parker, Joseph Richard, Avondale, 129, Kyverdale-road, Stoke Newington, N.
1894	Trans.	Parker, Matthew Archibald, Prof., B.Sc. (Glas.), University of Manitoba, Winnipeg, Canada
1882		‖Parker, Robert Henry, 35, Clifton-road, Maida Vale, W.
1901		Parkes, Albert Edward, F.I.C., Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890		Parkes, Thomas, M.A. (Cantab.), 2, Gawber-road, Barnsley
1906		‖Parkin, John, M.A. (Cantab.), Blaithwaite, Carlisle
1865	Trans.	‖Parkinson, James, Queen's-chambers, Pirie-street, Adelaide, S. Australia
1893		Parrish, Samuel, B.Sc. (Lond.), 80, Grange-avenue, Chapeltown-road, Leeds
1892		Parry, Ernest John, B.Sc. (Lond.), F.I.C., 208, High-street, Borough, S.E.
1903		Parry, William, B.Sc. (Lond.), 19, Hyde-road, Waterloo, Liverpool
1870		Patchett, Isaac, F.I.C., 59, Holyrood-terrace, Carlinghow, Batley
1894	Trans.	Paterson, David, F.R.S.E., Lea Bank, Rosslyn, Midlothian, N.B.
1885	Trans.	Patterson, George, F.I.C., The Manbré Saccharine Co., Hammersmith, W.
1896		Patterson, Joseph William, 20, South-road, West Hartlepool, Durham
1870	Trans.	Patterson, Thomas Law, F.I.C., Maybank, Finnart-street, Greenock
1904	Trans.	Patterson, Thomas Stewart, B.Sc. (Lond.), Ph.D. (Heidelberg), Chemical Department, The University, Glasgow

Date of Election.			
1863	Trans.	V.P. 1891-4	Pattinson, John, F.I.C., 10, Dean-street, Newcastle-on-Tyne
1868	Trans.		‖Paul, Benjamin Horatio, Ph.D. (Giessen), Analytical Laboratory, 13, Fenchurch-street, E.C.; and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D. (Tübingen), F.I.C., Market Hall-chambers, King-street, Huddersfield
1901			Pay, Walter Herbert, Government Laboratory, Durban, Natal
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Moseley-street, Newcastle-on-Tyne
1893			Payne, George Frederick, M.D. (Atlanta), 43½, Whitehall-street, Atlanta, Georgia, U.S.A.
1399	Trans.		Peachey, Stanley John, School of Technology, Whitworth-street, Manchester
1901			Peacock, Arthur, B.Sc. (Vict.), The Brebner Schools, Bloemfontein, S. Africa
1900			Pearce, Ernest Vivian, The Hollies, Hayle, Cornwall
1874			Pearce, William, M.P., Chemical Works, Bow Common, E.
1906			Pearse, Leonard Edward Beard, Venesta Factory, Kamarhati, Calcutta, India
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1902			Peck, John Wicliffe, 28, West Ella-road, Harlesden, N.W.
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.	V.P. 1907-	‖Pedler, Sir Alexander, Prof., C.I.E., F.R.S., F.I.C., 28, Stanhope-gardens, Queen's-gate, S.W.
1904			Pell, Alfred, 44, Cumballa-hill, Bombay, India
1906			Pendlebury, Harold Lawson, 4, Wentworth-street, Bolton
1886	Proc.		Pendlebury, William Henry, M.A. (Oxon.), Woodford House, Mountfield, Shrewsbury
1905			Penn, Francis Richard, A.R.C.S., Dene Head, Scotland-lane, Horsforth, near Leeds
1870			Penney, Mulgrave Daniel, 11, High-street, Hull
1895			Pennington, William Henry, Westgate, Longley-road, Worsley
1905			Pennycuick, Thomas, B.Sc. (Lond.), 6, Darley-drive, West Derby, Liverpool
1906			Pennymore, Percy George, Eskbank Iron and Steel Works, Lithgow, N.S.W.
1886			Pentecost, Stephen James, Nottingnam-road, New Basford, Notts.
1884	Trans.	C. 1906-	Perkin, Arthur George, Prof., F.R.S., F.I.C., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick Mollwo, Ph.D. (Würzburg), Borough Polytechnic, Borough-road, S.E.
1884	Trans.	C. 1891-5 V.P. 1906-	†Perkin, William Henry, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., Fairview, Wilbraham-road, Fallowfield, Manchester

† Longstaff Medallist, 1900.

Date of Election.			
1906			Perkins, William Hughes, B.Sc. (Manc.), The University, Leeds
1890	Trans.		‖Perman, Edgar Philip, D.Sc. (Lond.), University College, Cardiff
1905			Perrott, Bert, Ael-y-Bryn, Penywern-road, Neath, Glam.
1888			Perry, George Edward, 103, Stirling-road, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Mosley-street, Manchester
1902			Phelps, John, M.A. (Oxon.), The Royal Mint, E.; and Newcroft, Egmont-road, Sutton, Surrey
1881			Philip, Arnold, B.Sc. (Lond.), A.R.S.M., F.I.C., Chemical Laboratory, H.M. Dockyard, Portsmouth
1897	Trans.		Philip, James Charles, M.A. and D.Sc. (Aberd.), Ph.D. (Göttingen), Royal College of Science, South Kensington, S.W.
1887			Phillips, Arthur Gaved, A.R.S.M., F.I.C., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1904			Phillips, George Frederick Tyler, B.Sc. (Lond.), University College, Southampton
1897			Phillips, Harry Edward William, B.A. (Oxon.), The Laurels, Eynsham, Oxford
1882			Phillips, Henry Harcourt, Lynwood, Turton, Lancs.
1902	Trans.		Phillips, Percy Philip, Ph.D. (Göttingen), Thomason Engineering College, Rurki, North West Province, India
1900			Phillpotts, Geoffrey Surtees, B.A. (Cantab.), 82, James-street, Dublin
1905			Phipson, Percy Barker, c/o Messrs. J. Staples and Co., Ltd., Wellington, New Zealand
1897	Trans.		‖Pickard, Robert Howson, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), F.I.C., Municipal Technical School, Blackburn
1891			Pickering, Michael Samuel, B.Sc. (Lond.), 38, Price-street, Burslem
1878	Trans.	C.1886-7, 89-93, 1901-04.	‖Pickering, Spencer Percival Umfreville, M.A. (Oxon.), F.R.S., F.I.C., Harpenden, Herts.
1906	Trans.		Pickles, Samuel Shrowder, B.Sc. (Vict.), Imperial Institute, S.W.
1890	Trans.		‖Picton, Harold, B.Sc. (Lond.), Clacton College, Clacton-on-Sea
1894			Pike, Ernest Brooke, Grasmere, 515, Romford-road, Forest Gate, E.
1903			Pike, Henry George, 8, Eastbourne-avenue, Claremont-road, Bath
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D. (Göttingen), Sandhills, Salcombe, S.O., Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, Thomas William, 33, Grove-hill-road, Denmark Hill, S.E.
1904			Pinchbeck, Gerald, 10, Vernon-avenue, Eccles, Manchester
1889			Ping, William, 14, Selsdon-road, Wanstead, N.E.
1889			Pingstone, George Arthur, Public Analyst, P.O. Box 445, Bulawayo, S. Africa

Date of Election.		
1904		Pinkerton, David John, Crichton Cottage, Grange-street, Motherwell, N.B.
1881		Pisani, Orestes Victoriano, 56, Cavendish-road, Balham, S.W.
1903	Trans.	Pitt, Arthur Ernest, 66, Abbott-road, Bromley, E.
1903		Pitt, Harold Russell, 21, Parkview-terrace, Welling
1882		‖Pitt, Theophilus, 16, Coleman-street, E.C.
1899		Pittuck, Frederick Williams, St. Nicholas' Buildings West, Newcastle-on-Tyne
1899		Pizey, James Henry, A.R.C.S., F.I.C., Bella Vista 19, Minas de Rio Tinto, Provincia de Huelva, Spain
1893		Platt, Charles, M.D., Ph.D., Hahnemann Medical College, Philadelphia, U.S.A.
1860		‖Player, Jacob Hort, 16, Prince Arthur-road, Hampstead, N.W.
1899	Trans.	‖Plimmer, Robert Henry Aders, D.Sc. (Lond.), 3, Hall-road, N.W.
1903		Plymen, George Horace Gladstone, 44, Harlesden-gardens, Harlesden, N.W.
1907		Pochin, Harold, B.A. (Cantab.), 12, Chapel-street, Berkhamsted, Herts.
1899		Polkinghorne, Bennett Corcyra, B.Sc. (Lond.), 17, Humber-road, Blackheath, S.E.
1888		Pollard, Frederick Ernest, F.I.C., 14, Old Hall-street, Hertford
1898	Trans.	Pollard, William, M.A. (Cantab.), D.Sc. (Tübingen), The Museum, Jermyn-street, S.W.
1903		‖Pollard, William Branch, B.A. (Cantab.), Survey Department, Finance Ministry, Giza, Egypt
1902		Pollitt, George Paton, B.Sc. (Vict.), Ph.D. (Bâle), Winnington, Northwich, Cheshire
1901		Pollitt, James Charles Tomlin, 21, Endwood Court-road, Handsworth Wood, Birmingham
1896		Pollitt, Robert Barnabas, F.I.C., c/o Messrs. Gudgeons, Peecock and Prentice, Stowmarket, Suffolk
1897		Pollitt, Samuel, B.Sc. (Vict.), Tottenham County School, Grove House, South Tottenham, N.
1894	Trans.	‖Pollok, James Holms, D.Sc. (Glas.), Royal College of Science, Stephen's-green, Dublin
1903		Pond, George Gilbert, Prof., M.A. and Ph.D. (Amherst), State College, Pennsylvania, U.S.A.
1890		Pond, James Alexander, Auckland, New Zealand
1899		Ponthieu, Georges, 25, St. Jean Baptiste, Montreal, Canada
1848		Pontifex, Edmund Alfred, M.Inst.C.E., 6, Cadogan-court-gardens, Cadogan-place, S.W.
1905		Pooler, Frederick John, B.Sc. Birm.), 26, Green-street, Smethwick, Birmingham

Date of Election.			
1898	Trans.		Pope, Thomas Henry, B.Sc. (Birm.), A.C.G.I., F.I.C., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	†‖Pope, William Jackson, Prof., M.Sc. (Manc.), F.R.S., F.C.G.I. F.I.C., Corchester, Bramhall, Cheshire
1906			Porritt, Benjamin Dawson, Holly Lodge, 33, South-park-hill-road, South Croydon
1903			Porter, Robert James, 11, Arlington-street, Hull
1884	Proc.		‖Porter, Thomas Cunningham, M.A. and D.Sc. (Oxon.), Upton-park, Slough ; and Eton College, Windsor
1904			Porter, Thomas Linton Daniel, B.Sc. (Lond.), 161, Downsell-road, Stratford New Town, E.
1883			Potter, Charles Edward, c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland Samuel, Eastbury, Uplands-park-avenue, Loughton, Essex
1896			Potts, Henry William, Hawkesbury Agricultural College, Richmond, N.S.W.
1895			Powell, Harry James, 530, Lordship-lane, S.E.
1896	Trans.		Power, Frederick Belding, Ph.D. (Strassburg), 6, King-street, Snow-hill, E.C.
1884			‖Power, Francis Reginald, The Royal Mint, Melbourne, Australia
1902			Powney, William Edmund Francis, c/o the Mines Department, Edfou, Upper Egypt
1904	Trans.		Prentice, Bertram, Ph.D. (Munich), D.Sc. (Edin.), Royal Technical Institute, Salford
1902			Přibram, Richard, Hofrat Prof. Dr., Horlgasse 9, Vienna IX., Austria
1882			‖Price, Arthur Faraday, 2503, Broadway, San Francisco, Cal., U.S.A.
1899			Price, Robert Coleman, Prof., The Miller School, P.O., Albemarle Co., Va., U.S.A.
1901	Trans.		Price, Thomas Slater, D.Sc. (Lond. and Birm.), Ph.D. (Leipzig), F.I.C., Chemical Department, Municipal Technical College, Suffolk-street, Birmingham
1889			‖Priestley, Charles William, B.Sc. (Lond.), A.R.C.S., Richmond Lodge, Torquay
1871	Trans.		‖Procter, Henry Richardson, Prof., Hon. M.Sc. (Leeds), F.I.C., The University, Leeds ; and Rowangarth, Ben Rhydding, viâ Leeds
1889	Trans.		Proctor, Charles, F.I.C., 27, London-road, Forest Hill, S.E.
1896	Proc.		Proude, James, 30, Cromwell-terrace, Halifax
1897			Pullar, Herbert Spindler, Pullar's Dye Works, Perth, N.B.
1882			‖Pullar, Rufus Daniell, Brahan, Perth, N.B.
1902			Puntan, Herbert Harding Cruikshank, Borough Analyst, London-chambers, Durban, Natal, S. Africa

† Longstaff Medallist, 1903.

Date of Election.			
1875	Trans.	C. 1888-92 V.P. 1899-1902	Purdie, Thomas, Prof., Ph.D. (Würzburg), Hon. LL.D. (Aberd.), B.Sc. (Lond.), F.R.S., A.R.S.M., F.I.C., The University, St. Andrews, N.B.
1901	Proc.		Purvis, John Edward, M.A. (Cantab.), A.R.C.S.I., F.I.C., University Chemical Laboratory, Cambridge
1906			Pye, Thomas Ebenezer, Clovelly, Chichester, Sussex
1886			Pyke, Lazarus Simon Magnus, Assoc.M.Inst.C.E., M.Inst.E.E., 10, Westbourne-terrace, Hyde Park, W.
1905	Trans.		Pyman, Frank Lee, M.Sc. (Vict.), Ph.D. (Bâle), Carlee, Selborne-road, Sidcup, S.O., Kent
1905			Quant, Ernest, 2, Park-crescent, Torquay
1868			Quibell, Oliver, Shalem Lodge, Newark
1894			Quinn, Gerald Grattan, A.R.C.S., 6, Glenroyd, Spotland, Rochdale
1901			Radcliffe, Lionel Guy, 6, Alma-terrace, Old Trafford, Manchester
1902			Ralphs, Edwin, Queen's College, Hong Kong
1897			Ralston, William, B.Sc. (Lond.), F.I.C., 3, Windsor-terrace, Linthouse, Govan, Glasgow
1892	Trans.		‖Ramage, Hugh, M.A. (Cantab.), A.R.C.S.I., F.I.C., Ridgemont, Carrow-hill, Norwich
1873	Trans.	C. 1886-9 V.P. 92-5, 1897-1900 F.S. 1902-1907 P. 1907-	†‖Ramsay, Sir William, K.C.B., Ph.D. (Tübingen), Hon. LL.D. (Glas.), Hon. Sc.D. (Dub. and Cantab.), Hon. D.Sc. (Oxon., L'pool and Columbia), F.R.S., F.I.C., University College, W.C.; and 19, Chester-terrace, Regent's Park, N.W.
1901			Ramsden, William Cecil, 107, Moyne-road, Rathmines, Dublin
1902			Ramshaw, Walter, Beech Cottage, Shaftesbury, Dorset
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1905			Ratcliffe, William Henry, B.Sc. (Lond.), 3, Dowanhill-gardens, Hither-green-lane, S.E.
1906			Rawles, Walter Hansen, 81, Lewisham High-road, S.E.
1880			‖Rawson, Christopher, F.I.C., 2, Melbourne-place, Bradford
1884	Trans.		‖Rawson, Sidney George, D.Sc. (Lond.), F.I.C., Red Hill House, London-road, Worcester
1898			Ray, John Armstedt, jun., B.A. (Dub.), 15, Nassau-street, Dublin
1902	Trans.		Rây, Prafulla Chandra, Prof., Presidency College, Calcutta
1889	Trans.		‖Read, Arthur Avery, F.I.C., 3, Fitzalan-place, Cardiff
1895			Read, Edwin James, B.A. (Cantab.), F.I.C., St. Ives, The Avenue, Gravesend, Kent

† Longstaff Medallist, 1897.

Date of Election.			
1899	Trans.		Read, Harold McLean, 19, Baronsmead-road, Castlenau, Barnes, S.W.
1900			Readman, James Fraser, 8, Park-avenue, Glasgow
1890			Redding, Richard James, 29, Isla-road, Plumstead, Kent
1906			Redgrove, Herbert Stanley, 137-140, Tottenham-court-road, W.
1892			Redman, Henry Ramsden, 60, Nelson-road, Gillingham, Kent
1866		C. 1891-2	Redwood, Sir Boverton, Hon. D.Sc. (Ohio), F.R.S.E., F.I.C., 4, Bishopsgate-street-within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, Theophilus Horne, F.I.C., 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D. (Berne), 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrsthof, 19, South Park-hill-road, South Croydon
1880			‖Regester, William, Lawn Lodge, Isleworth, Middlesex
1897			Reid, Alexander Ferguson, Edgemont, Nevada, U.S.A.
1893			Reid, Thomas Anderson, 5, Adelaide-terrace, Waterloo, near Liverpool
1881			‖Reid, Walter Francis, F.I.C., Fieldside, Addlestone, Surrey
1907	Trans.		Remfry, Frederic George Percy, B.A. (Cantab.), D.Sc. (Geneva), 36, Highfield-road, Dartford, Kent
1897			Remington, John Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1886			Remington, Joseph Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1879	Trans.		Rennie, Edward Henry, Prof., D.Sc. (Lond.), F.I.C., The University, Adelaide, S. Australia
1898	Proc.		Renwick, Frank Forster, Cromer Villa, Warley-road, Brentwood, Essex
1902	Trans.		Revis, Cecil, 77, King-street, Hammersmith, W.
1873	Trans.	V.P. 1881-4, 89-92, 97-1900. P. 1901-1903.	Reynolds, James Emerson, Prof., Hon. Sc.D. and Hon. M.D. (Dub.), M.R.C.P. (Ireland), L.R.C.P. and S. (Edin.), F.R.S., 29, Campden-hill-court, Kensington, W.
1898	Trans.		Reynolds, William Colebrook, B.Sc. (Lond.), Roseleigh, Essex-road, Dartford, Kent
1907			Rhodes, Percy Joseph, Bridge House, Church, Lancs.
1898	Trans.		Rich, Edward Milton, 18, Manor-road, Forest Hill, S.E.
1903			Rich, Stiles William George, c/o Messrs. Thomason Chater, Ltd., Stanley-street, South Brisbane, Queensland
1889			Richards, Duncan Taylor, 57, Osborne-avenue, Westoe-lane, South Shields
1889			‖Richards, Edgar, c/o G. K. Richards, Esq., 16, Lafayette-square, Washington, D.C., U.S.A.

Date of Election.			
1905			Richards, Frederick George, 21, Dutton-street, Manchester
1889			‖Richards, Percy Andrew Ellis, F.I.C., 51, Rowan-road, Brook Green, W.; and Charing Cross Hospital Medical School, W.C.
1886			Richards, William, B.Sc. (Lond.), The Clock House, Tooting, S.W.
1885	Trans.		‖Richardson, Arthur, The Central Hindu College, Benares, N.W.P., India
1888	Trans.		‖Richardson, Clifford, New York Testing Laboratory, Maurer, N.Y., U.S.A.
1906			Richardson, Frederic Ion, B.A. (Cantab.), Wynna, Walpole-street, Kew, near Melbourne, Australia
1883			Richardson, Frederic William, F.I.C., Oak Lea, Menston, Leeds
1903			Richardson, Harold Ernest, B.A., B.Sc. (Lond.), 1, Penlee-view-terrace, Penzance, Cornwall
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert Naylor Bardsley, B.A. (Cantab.), 10, Friar-lane, Leicester
1866			Richardson, Joseph, Pansei View, Arran-avenue, Marsland-road, Sale, Manchester
1906			Richardson, Lawrence George, 14, Ash-grove, Horton, Bradford
1892			Richardson, Reginald Edensor Stanley, 10, Friar-lane, Leicester
1887	Trans.		Richmond, Henry Droop, F,I.C., 8, Woodfield-road, Ealing, W.
1902			Ricketts, Guy Dunstan, M.A. (Cantab.), 25, Huskisson-street, Liverpool
1894			Riddick, David Gibson, Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc. (Lond.), F.I.C., 28, Victoria-street, Westminster, S.W.
1882	Trans.		Ridsdale, Charles Henry, F.I.C., Ravenscroft, Roman-road, Linthorpe, Middlesbrough
1888			Rigby, John Samuel, 26, Bagot-street, Wavertree, Liverpool
1905			Rigby, Thomas, c/o Messrs. Crossley Bros., Ltd., Openshaw, Manchester
1898			Rigg, Gilbert, c/o The New Jersey Zinc Co., Palmerton, Carbon Co., Pa., U.S.A.
1851	Trans.	C. 1878-80	Riley, Edward, F.I.C., 14A, Finsbury-square, E.C.
1904			Riley, Louis John Eczekiel, F.I.C., 8, Newton-road, W.
1900			Riley, Walter Alfred, Hazeldene, College-road, Norwich
1893			Rintoul, William, F.I.C., Royal Gunpowder Factory, Waltham Abbey
1907			Rixon, Frederic William, M.Sc. (Vict.), Ph.D. (Giessen), 76, Kingsdown-parade, Bristol
1902			Roast, Harold James, Y.M.C.A., Montreal, Quebec, Canada
1893			Robbins, James Henry, B.Sc., 4, Selborne-road, Ilford, Essex
1897			Roberts, Ernest Henry, 81, Cicada-road, Wandsworth, S.W.

Date of Election.		
1883		‖Roberts, Frederick George Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899		Roberts, James, jun., 43, Great Western-road, Glasgow
1876		Roberts, Martin Fenn, General Post Office, E.C. ; and Mabshill, Epsom
1889		Roberts, Richard Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894		Roberts, Thomas John, Ingleside, Park-road, Huyton, nr. Liverpool
1880		Roberts, William Brittain, Wilderspool House, Warrington, Lancs.
1894		Robertson, Archibald Blair, Struan, Giffnock, Glasgow
1904		Robertson, Franklin Ernest, Gloster House, Harders-road, Peckham, S.E.
1903		Robertson, Frederick Duncan Struan, The Hewan, Bearsden, Glasgow
1903	Trans.	Robertson, Philip Wilfred, M.A. (N.Z.), Trinity College, Oxford
1907	Trans.	Robertson, Robert, M.A. and D.Sc. (St. Andrew's), F.I.C., Research Department, Royal Arsenal, Woolwich, S.E. ; and 29, Charlton-road, Blackheath, S.E.
1901	Trans.	Robertson, William, 21, Worfield-street, Battersea Park, S.W.
1889		Robins, Harry Hollis, c/o Messrs. Southwell and Co., Dockhead, S.E.
1903		Robinson, Archibald Louis, M.A. (Dub.), St. Maur, Palmerston-park, Dublin
1896		Robinson, Henry Fishwick, M.Sc. (Vict.), 2, Richmond-street, Droylsden-road, Newton Heath, Manchester
1882	Trans.	‖Robinson, Henry Haliburton, M.A. (Oxon.), F.I.C., 75, Finborough-road, West Brompton, S.W.
1895		Robinson, Herbert Lewin, The Plating Co., 10, Kirby-street, Hatton-garden, E.C.
1907		Robinson, John, Agricultural College, Aspatria, Cumberland
1906		Robinson, Reginald Ernest, B.A. (Cantab.), The Villas, Stoke-on-Trent
1901		Robinson, William Hammond, Kendrick House, Victoria-road, Penarth, Glam.
1904		Rodger, Robert, 54, Rostrevor-road, S.W.
1898		Rofe, Henry John, M.A. (Oxon.), 8, Victoria-street, Westminster, S.W.
1883		Rogers, Arthur William, Tadcaster Tower Brewery Co., Tadcaster
1884		Rogers, Francis Murray, 21, Burma-road, Stoke Newington, N.
1905		Rogers, Harold Rudolf, M.A. (Oxon.), 19, King-street, Newcastle, Staffs.
1903		Rogers, William David, A.R.C.S., A.I.C., 36, Grange-road, Smethwick
1906	Trans	Rogerson, Harold, M.Sc. (Manc.), 6, King-street, Snow Hill, E.C.

Date of Election.			
1894			Rolfe, John F., 50, South-street, Greenwich, S.E.
1903			Roose, Fitzroy Owen Jonathan, Assoc.Inst.E.E., 18, Vincent-square-mansions, Westminster, S.W.
1855	Trans.	C.1860-4, 1871-3 V.P.73-5, 1877-80 P. 80-2	Roscoe, Sir Henry Enfield, B.A., D.C.L., (Oxon.), LL.D. (Cantab., Dub., Glas., Montreal, Aberd.), Ph.D. and Hon. M.D. (Heidelberg), Hon. D.Sc. (Vict.), F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8.	‖Rose, Thomas Kirke, D.Sc. (Lond.), 6, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D. (Würzburg), 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, F.I.C., 1, Glengall-road, Old Kent-road, S.E.
1905			Ross, Frederick Wilson Montrose, 21, Soho-square, W.
1902			Ross, George Archibald Park, M.B., Ch.B. and D.P.H. (Edin.), 69, Leamington-terrace, Edinburgh
1881			Ross, Henry, Rev., LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, Raymond St. George, F.I.C., Public Analyst, Burnley
1902			Ross, William Charles, Capt., I.M.S., M.B., Ch.B. and D.P.H. (Edin.), Deputy Sanitary Commissioner, Bankipore, E.I.R., Bengal, India
1891	Proc.		Rossiter, Edmund Charles, F.I.C., 4, Park-road, West Smethwick, Birmingham
1896			Rostron, Harold, B.Sc. (Vict.), 699, Manchester-road, Bolton
1892			Rothwell, Charles Frederick Seymour, Beech Croft, Mobberley, Knutsford
1904			Rouillard, Marie Jean Louis Ernest, B.Sc. (Edin.), Malvern, Natal, S. Africa
1899			Roundell, Christopher Foulis, B.A. (Oxon.), Lieut., Guards' Club, Pall Mall, S.W.
1900			Row, Mysore Chavan Nanjunda, B.A., M.B. and C.M. (Madras), Mylapore, Madras, India
1905			Rowland, James Frederick Fothergill, B.A. (Cantab.), 18, Kingdon-road, West Hampstead, N.W.
1905			Rowley, Henry, M.Inst.E.E., 81, Barrack-street, Perth, Western Australia
1906			Rowsell, Philip Foale, Nutbrook, Exmouth, S. Devon
1900			Roy, Mathura Goolab, Chintadirpetah, Madras, India
1899			Royal-Dawson, Henry, c/o Messrs. Peyton and Son, Lister-street, Birmingham; and 6, Wimborne-road, Edgbaston, Birmingham
1901			Royle, Charles Leonard, c/o Messrs. Parry and Co., Madras, India
1905			Royle, Harold Marmion, 12, Barfield-villas, George-lane, South Woodford, Essex
1872	Trans.		Ruffle, John, F.I.C., Musley, Ware, Herts.

Date of Election.			
1895			Rugginz, William Augustus, Strathmore, 1, Salisbury-road' Grove-road, Walthamstow, Essex
1889	Trans.	C. 1903-05	Ruhemann, Siegfried, M.A. (Cantab.), Ph.D. (Berlin), Gonville and Caius College, Cambridge
1883			Rumble, Charles, F.I.C., 9, Sangora-road, New Wandsworth, S.W.
1890			‖Russell, Edward, B.Sc. (Lond.), F.I.C., 18, Woodstock-road, Redland-green, Bristol
1899	Trans.		Russell, Edward John, D.Sc. (Lond.), Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.
1901			Russell, James Bertram, B.Sc. (Lond.), 201, Hyde-park, Leeds
1851	Trans.	C. 1863-7, 1870-2 V.P. 1872-3 S. 1873-5 T. 1875-89 P. 1889-91	‖Russell, William James, Ph.D. (Heidelberg), F.R.S., F.I.C., 34, Upper Hamilton-terrace, St. John's Wood, N.W.
1896			Rutter, Thomas Francis, B.Sc. (Lond.), Ph.D. (Leipzig), Newcastle-under-Lyme
1894			Ryce, George, B.A. (R.U.I.), Irish Agricultural Offices of the Potash Syndicate, 50, Essex-street, Dublin
1901	Trans.		Ryffel, John Henry, M.A. (Cantab.), B.Sc. (Lond.), 10, Grasmere-road, Muswell Hill, N.
1888			‖Sach, Albert John, Technical College, Goulburn, N.S.W.
1868			Sadler, Sir Samuel Alexander, Col., Cleveland Chemical Works, Middlesbrough
1896			Sage, Charles Edward, 160 and 162, Kennington-park-road, S.E.
1907			Sahni, Ruchi Ram, M.A., Government College, Lahore, India
1879	Trans.		‖Sakurai, Joji, Prof. Science College; Imperial University, Tokio, Japan
1880			Salamon, Alfred Gordon, A.R.S.M., F.I.C., 1, Fenchurch-avenue, E.C.
1906			Salmon, Frederick John, c/o Miss Huber, 26, Fordhook-avenue, Ealing, W.
1876			‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and 49, Grosvenor-street, W.
1863			‖Salt, Henry, M.D. and C.M. (Edin.), Inglewood, Great Malvern
1871			‖Salter, Mortyn John, F.I.C., Greyrickhouse, Mickleton, S.O., Glos.
1859			‖Salter, Thomas William, 193, Priory-road, West-hill, Hastings
1907	Trans.		Salway, Arthur Henry, B.Sc. (Lond.), Ph.D. (Leipzig), 51, Goodmayes-avenue, Goodmayes, near Ilford, Essex
1902			Sampson, John William, Cleveland Pharmacy, Bath
1882			Samuel, William Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.

Date of Election.		
1898	Trans.	Sand, Henry Julius Salomon, Ph.D. (Zürich), D.Sc. (Birm.), University College, Nottingham
1870		‖Sandberg, Christer Peter, Palace-chambers, 9, Bridge-street, Westminster, S.W.
1900	Proc.	Sanders, James McConnell, c/o Direccion General de Aduanas, Mexico
1904		Sanders, Percy Richard, West Cliffe, Seaford, Sussex
1888		Sanderson, John, F.I.C., c/o Messrs. B. S. Cohen, Ltd., 15, Clerkenwell-close, E.C.
1901		Sandford, Thomas, 8, Market-street, Dalton-in-Furness
1882		Sanford, Percy Gerald, F.I.C., Laboratory, 20, Cullum-street, E.C.
1890		Saniter, Ernest Henry, Strafford Villa, Moorgate, Rotherham
1891		Sanyal, Abhayacharan, Prof., M.A. (Calcutta), Queen's College, Benares, N.W.P., India
1906		Sanyal, Surendra Prasad, M.A. (Calcutta), The Rajbati, Majhauli Raj P.O., Gorakhpur District, U.P., India
1892		Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900		Sargeant, Fred Pilkington, College of Pharmacy, Clarendon-road, Leeds
1886		Saunders, William, Prof., Experimental Farm, Ottawa, Canada
1898		Sayer, Harold Charles, 51, Highfield-road, Dartford
1890		Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885		Scammell, Luther Robert, c/o Messrs. F. H. Faulding & Co., 54, King William-street, Adelaide, S. Australia
1877		Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897		Scargill, Lionel Walter Kennedy, M.A. (Oxon.), 10, Castle-hill, Cambridge
1893	Trans.	Schidrowitz, Philip, Ph.D. (Berne), 57, Chancery-lane, W.C.
1888		‖Schieffelin, William Jay, Ph.B. (Columbia), 840, Southern-boulevard, New York, U.S.A.
1907		Schlinger, Charles, B.Sc. (Lond.), Acadia House, 273, Camden-road, N.
1905		Schnurmann, Harry Nestor-, c/o Messrs. Fraser and Chalmers, Ltd., Calle San Martin 195, 2, Piso, Buenos Ayres, S. America
1892		‖Schofield, James Alexander, A.R.S.M., F.I.C., The University, Sydney, N.S.W.
1903		Scholefield, Alfred Henry, B.A. and B.Sc. (Lond.), 57, The Avenue, Leigh, Lancs.
1905	Trans.	Scholefield, Fred, M.Sc. (Vict.), B.Sc. (Lond. and Leeds), A.I.C., 4, Rutland-street, Unthank-road, Norwich
1902		Scholes, William, Mount Sion, Radcliffe, Lancs.
1899	Trans.	Schryver, Samuel Barnett, D.Sc. (Lond.), Ph.D. (Leipzig), 27, Arundel-gardens, Notting Hill, W.

Date of Election.			
1896			Scotland, Peter Bain, c/o The Arizona Copper Co., Ltd., Metcalf Mines, Clifton, Arizona, U.S.A.
1879	Trans.	C. 1897-9 S. 1899-1904 T. 1904-	‖Scott, Alexander, M.A. and Sc.D. (Cantab.), D.Sc. (Edin.), F.R.S., F.I.C., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.; and 13, Neville-court, Abbey-road, N.W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, George Charlton, c/o W. Scott, Esq., Eston Grange, Grangetown, S. O., Yorks.
1905			Scott, John Irwin, M.A. (Oxon.), Trent College, Long Eaton, Derbyshire
1906			Scouller, Walter Daly, B.Sc. (Vict.), Chester Corporation Sewage Purification Works, Chester
1883	Proc.		Scudder, Frank, F.I.C., 44, Mosley-street, Manchester
1906			Seaber, Willie Macro, B.Sc. (Lond.), A.I.C., Firdale, Sheen-lane, East Sheen, S.W.
1896			Seabrooke, Herbert Cecil, F.I.C., Black Ash, Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup, S.O., Kent
1890			Seaton, Edward Cox, M.D. (Lond.), M.R.C.S. (Eng.), F.R.C.P. (Lond.), F.I.C., 93, St. George's-square, S.W.
1905			Seaton, William Dunham, 40, Argyle-road, Ilford, Essex
1899			Seligman, Richard, Ph.D. (Heidelberg), A.C.G.I., 33A, High-street, Kensington, W.
1892	Trans.	C. 1905-	Sell, William James, M.A., Sc.D., (Cantab.), F.R.S., F.I.C., University Chemical Laboratory, Pembroke-street, Cambridge
1875			Sellon, John Scudamore, 78, Hatton-garden, E.C.
1906			Sen, Gopal Chandra, M.A. (Calcutta), 210, Cornwallis-street, Calcutta, India
1904	Trans.		Sen, Jatindranâth, M.A. (Calcutta), Agricultural Research Institute, Pusa, Bengal, India
1875	Trans.		‖Senier, Alfred, Prof., M.D. (Mich.), Ph.D. (Berlin), F.I.C., Queen's College; and Gurthard, Galway
1887			Senier, Harold, F.I.C., Hanley House, Ryde, Isle of Wight
1899			Senior, George, B.A. (Lond.), 109, Brynland-avenue, Bishopston Bristol
1906			Senior, John, c/o Messrs. Hargreaves, Bros. and Co., Ltd., Starch, Blue and Blacklead Works, Hull
1903	Trans.		Senter, George, Ph.D. (Leipzig), B.Sc. (Lond.), Chemical Laboratory, St. Mary's Hospital Medical School, Paddington, W.
1905			Setterington, Douglas Temple, 45, Regent-road, Blackpool, Lancs.
1896			Severn, Walter Dalrymple, A.R.C.S., Public Health Laboratory, Cape Town, S. Africa
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.

Date of Election.			
1907			Sewell, William George, B.Sc. (Lond.), Bournemouth School, Bournemouth
1874			‖Sexton, Alexander Humboldt, Prof., F.I.C., F.R.S.E., Glasgow and West of Scotland Technical College, 204, George-street, Glasgow
1895			Seyler, Clarence Arthur, B.Sc. (Lond.), F.I.C., The Technical Institute, Nelson-terrace, Swansea
1904			Shacklady, Thomas George, c/o British Turpentine Corporation, Ltd., Hayes, Middlesex
1880			Shadwell, John Emilius Lancelot, F.I.C., Charlecote, Lansdown, Bath
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, Shirley Manor, Wyke, near Bradford
1895			Sharrott, Thomas Chilwell, B.A. (Dub.), A.R.C.S., F.I.C., Bovey Tracey School, Devon
1895	Trans.		‖Shaw, George Elliott, B.Sc. (Lond.), F.I.C., Assistant Quinologist, Mungpoo, Sonada, P.O., D.H. Railway, Bengal, India
1887			Sheard, John Tomlinson, Birley Carr, Sheffield
1905	Trans.		Shedden, Frank, B.Sc. (Lond.), F.I.C., 17, Raby-street, Rawtenstall, Manchester
1899			Shelbourn, Edward Thomas, F.I.C., 40, Craven-street, Strand, W.C.
1904	Proc.		Shelton, Henry Stanley, B.Sc. (Lond.), Rushmere, Lower-park-road, Hastings
1876	Trans.	C. 1893-7	‖Shenstone, William Ashwell, F.R.S., F.I.C., 46, College-road, Clifton, Bristol
1897			Shenton, James Porter, 37, Torbay-road, Chorlton-cum-Hardy, near Manchester
1907	Trans.		Shepheard, Frederick George, B.Sc. (Lond.), A.R.C.S., A.I.C., Northrepps, Norwich
1899	Trans.		Shepheard, William Frederick John, 12, Bridge-street-row, Chester
1906			Shepherd, Arthur Burton, B.Sc. (Vict.), F.I.C., c/o The British Oil and Cake Mills, Ltd., Copenhagen Mill, Limehouse, E.
1905			Shepherd, Charles Stuart, Rev., Worth Matravers Vicarage, Wareham, Dorset
1874			‖Shepherd, Harcourt Henry Benjamin, F.I.C., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899			Shepherd, John William, B.Sc. (Lond.), 5, Cleveland-avenue, Merton Park, S.W.
1901	Trans.		Sheppard, Samuel Edward, D.Sc. (Lond.), 100, Bromley-road, Catford, S.E.
1901			Shepperson, William, The Pryors, East Heath-road, Hampstead, N.W.
1901			Sherwood, Edward Charles, Rev., M.A. (Oxon.), St. Laurence College, Ramsgate

Date of Election.		
1891	Trans.	‖Shields, John, D.Sc. (Edin.), Ph.D. (Strassburg), F.I.C., 4, Stanley-gardens, Willesden Green, N.W.
1896		Shimomura, Kotaro, Prof., Osaka Seimi Works Co., Kawagishicho, Nishiku, Osaka, Japan
1894		Shorthouse, Herbert Stephen, 47, Pershore-road, Birmingham
1906		Shrimpton, John Kirby, 22, Fountain's-terrace, North-road, Ripon
1904		Shrubsole, Alfred, 18, Forest-drive-west, Leytonstone, N.E.
1886		Shutt, Frank Thomas, M.A. (Toronto), F.I.C., Experimental Farm, Ottawa, Canada
1890		Shuttlewood, Willis Brewin, 78, Whitehall-park, Hornsey-lane, Highgate, N.
1894		Shuttleworth, Edward Buckingham, Prof., 220, Sherborne-street, Toronto, Canada
1904		Siau, Raymond Louis, 15, Merridale-lane, Wolverhampton
1903		Sibley, Samuel Edward, Tottenham, Warren-road, Marrickville, Sydney, N.S.W.
1859		Sibson, Alfred, 23, St. Mary Axe, E.C.
1889		Sibson, Alfred Edward, 19, Carlingford-road, Hampstead, N.W.
1903		Siddle, George, Middleton-one-row, S.O., Co. Durham
1902	Proc.	‖Sidgwick, Nevil Vincent, M.A. (Oxon.), D.Sc. (Tübingen), Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D. (Würzburg), Buckhurst Hill, S.O., Essex
1886		Silvester, Harry, Hon. B.Sc. (Birm.), F.I.C., 78, Holy Head-road, Handsworth, Birmingham
1906		Sime, Allan, Box 19, Port Limon, Costa Rica, S. America
1899	Trans.	Simmonds, Charles, B.Sc. (Lond.), Airdrie, 61, Cottenham-park-road, Cottenham-park, Wimbledon, S.W.
1889		Simmonds, Henry, Engineer's Office, Gas Works; and Elton View House, Bury, Lancs.
1887		‖Simmons, Leonard Owen, 2, Electric-mansions, Electric-avenue, Brixton, S.W.
1905		Simmons, William Herbert, B.Sc. (Lond.), Oakleigh, Stoke Newington Common, N.
1895		Simons, Albert Joseph, c/o M. Simons, Esq., 31, Little Britain, E.C.
1906	Trans.	Simonsen, John Lionel, M.Sc. (Manc.), 152, Barlow-moor-road, West Didsbury, Manchester
1896		Simpson, Aitken Migget, 364, Stanstead-road, Catford, S.E.
1902		Simpson, Duncan Ivan Rennard, P.O. Box 4225, Johannesburg, S. Africa
1897		Simpson, Edward Sydney, B.E. (Sydney), Geological Survey Laboratory, Museum-street, Perth, Western Australia
1886	Proc.	‖Simpson, William Selby, F.I.C., 17, Lake Side-road, Palmer's Green, N.
1902	Proc.	Sindall, Robert Walter, 201, Wellmeadow-road, Catford, S.E.

Date of Election.		
1889		Singer, Ignatius, 3, Parkfield-road, Manningham, Bradford
1902	Proc.	Sinnatt, Frank Sturdy, Glenside, Church-lane, Moston, Manchester
1896		‖Sircar, Amrita Lal, 51, Sankaritola, Calcutta, India
1902		Skertchly, William Pearson, F.I.C., 11, Billiter-square, E.C.
1888	Trans.	Skinner, Sidney, M.A. (Cantab.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1899	Trans.	Skirrow, Frederick William, M.Sc. (Vict.), Ph.D. (Leipzig), 17, Curzon-avenue, Victoria-park, Manchester
1892		Skurray, Thomas, United Breweries, Abingdon, Berks.
1879		Slater, Charles, M.A. and M.B. (Cantab.), M.R.C.S. (Eng.), 81, St. Ermin's-mansions, Westminster, S.W.
1880	Trans.	‖Slater, Harold Humboldt, F.I.C., St. Lawrence, Borstal-road, Rochester, Kent
1903	Trans.	Slator, Arthur, Ph.D. (Leipzig), M.Sc. (Birm.), B.Sc. (Lond.), F.I.C., The Priory, Burton-on-Trent
1878		‖Slatter, George William, A.R.C.S.I., F.I.C., 241, Carlton-terrace, Nab Wood, Shipley, Yorks.
1895		Slocum, Frank Leroy, 401, South Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		‖Smetham, Alfred, F.I.C., Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1898	Trans.	Smiles, Samuel, D.Sc. (Lond.), University College, Gower-street, W.C.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	‖Smith, Alexander, Prof., Ph.D. (Munich), B.Sc. (Edin.), University of Chicago, Chicago, Ill., U.S.A.
1901		Smith, Andrew Biggam, c/o M. Armstrong, Esq., P.O. Box 90, Queenstown, Cape Colony, S. Africa
1888		Smith, Angus, F.I.C., 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, Benjamin Jordan, 25, Charch Fouard, Choubrah, Cairo, Egypt; and 58, King's-road, Reading
1906		Smith, Charles, Knowsley-road, Smithills, Bolton
1903		Smith, Charles Joseph, Sunnydale, Walton New-road, Stockton Heath, near Warrington
1904	Trans.	Smith, Clarence, D.Sc. (Lond.), Aldersyde, Harpenden-road, Wanstead Park, E.
1894	Trans.	Smith, Claude, F.I.C., Barngarth, Cartmel, Carnforth
1884		‖Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1900		Smith, Edward Shrapnell, 4, Raymond-buildings, Gray's Inn, W.C.
1906		Smith, Frank, B.Sc. (Vict.), 407, Church-road, Smithills, Bolton
1903		Smith, Frank Gurney, 11, Albert-road, Ramsgate
1906		Smith, Fred, Cliff House, Bruntcliffe, Leeds
1874		Smith, George, Nobel's Explosives Co., Polmont Station, N.B.
1896		Smith, George Egerton Scott-, F.I.C., 67, Surrey-street, Sheffield

Date of Election.			
1892			‖Smith, George Percy Darnell-, B.Sc. (Lond.), F.I.C., The Merchant Venturers' Technical College, Castle-green Branch, Bristol
1904			Smith, Gerald Oscar Morgan-, Watton-road, Swaffham, Norfolk
1901			Smith, Henry Ewing, 22, City-road, E.C.
1896	Trans.		Smith, Henry George, The Technological Museum, Sydney, N.S.W.
1904			Smith, Henry Heron, F.I.C., 76, Plumstead-common-road, Plumstead, Kent
1878			Smith, Henry Russell, F.I.C., 1, Aubert-park, Highbury, N.
1900			‖Smith, Herbert Procter, Shotton-lane, Shotton, Flints.
1890			Smith, Harry Wood, B.Sc. (Vict.), c/o Messrs. John Batt and Co., Ltd., 39, Old Broad-street, E.C.
1901			Smith, James, 80, Ampthill-road, Aigburth, Liverpool
1903			Smith, James Cruickshank, B.Sc., Holmdene, Colebrook-avenue, West Ealing, W.
1879			Smith, John William, 7, Brookfield-street, Roslindale, Boston, Mass., U.S.A.
1902			Smith, Leonard, Hillside, Park-hill-road, Croydon
1901	Trans.		Smith, Norman, D.Sc. (Vict.), The University, Manchester
1902			Smith, Robert Ely Blake, B.Sc. (Lond.), A.I.C., 31, St. John's-road, Putney, S.W.
1897			Smith, Robert Francis Wood, 90, Lower Thames-street, E.C.
1891			Smith, Robert Greig-, D.Sc. (Edin.), M.Sc. (Dun.), Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1907			Smith, Robert Low, 56, Genesta-road, Plumstead, S.E.
1888			Smith, Samuel, Hillsboro', Goddard-avenue, Old Swindon
1907			‖Smith, Sydney William, B.Sc. (Lond.), A.R.S.M., 76, Norroy-road, Putney, S.W.
1866	Trans.		Smith, Watson, F.I.C., 34, Upper-park-road, Haverstock Hill, N.W
1876			‖Smith, William Alexander, M.A. and M.B. (Oxon.), M.R.C.S. (Eng.), Newport, S.O., Essex
1903			Smith, William Veysey, B.A. (Oxon.), 29, Newmarket-road, Norwich
1883	Trans.	C. 1896-1900. V.P. 1905-	‖Smithells, Arthur, Prof., B.Sc. (Lond.), F.R.S., F.I.C., The University, Leeds
1873			‖Smyth, John, M.A. (Dub.), M.Inst.C.E., Milltown, Banbridge, Ireland
1902			Smythe, John Seabury, B.Sc. (Vict.), Ph.D. (Würzburg), Rantallard, Lance-lane, Wavertree, Liverpool
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc. (Lond.), Ph.D. (Göttingen), F.I.C., Balholm, Lathom-road, Southport
1899	Trans.		Soddy, Frederick, M.A. (Oxon.), Chemical Department, The University, Glasgow

Date of Election.		
1887		Sohn, Charles Emile, F.I.C., 2, Harpur-street, Bedford-row, W.C.
1891		Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1906		Sommerville, David, B.A. (R.U.I.), M.D., B.Ch., and D.P.H. (Cantab.), M.R.C.P. (Lond.), 31, Manor House, Marylebone-road, N.W.
1874	Trans.	Sonstadt, Edward, Church Field, Cheshunt, Herts.
1893		Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875		Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897	Proc.	Southerden, Frank, B.Sc. (Lond.), F.I.C., Royal Albert Memorial College, Exeter
1897		Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902		Southworth, William, Agricultural and Horticultural College, Uckfield, Sussex
1883		Soward, Alfred Walter, 28, Therapia-road, Honor Oak, S.E.
1892		Spackman, Charles, Rosehaugh, Clitheroe, Lancs.
1905		Speight, William Ewart, Corporation Sewage Works, Deighton, Huddersfield
1883		‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1906	Trans.	Spencer, James Frederick, D.Sc. (L'pool), B.Sc. (Vict.), Ph.D. (Breslau), Bedford College for Women, Baker-street, W.
1886		Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887		‖Spencer, Walter Shelley, Lyndene, Darley-grove, Farnworth, near Bolton
1894		Spenzer, John George, Prof., M.D., Ph.D. (Strassburg), Ohio Wesleyan University, 1825, East 93rd street, N.E., Cleveland, Ohio, U.S.A.
1904		Spielmann, Percy Edwin, B.Sc. (Lond.), A.R.C.S., A.I.C., 21, Cadogan-gardens, S.W.
1859	Trans.	‖Spiller, John, F.I.C., 2, St. Mary's-road, Canonbury, N.
1863		‖Spiller, William, F.I.C., 2, Lindfield-gardens, Hampstead, N.W.
1885		‖Spottiswoode, William Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1906	Trans.	Sproxton, Foster, B.Sc. (Lond.), Brantham Works, near Manningtree, Essex
1882		‖Squire, Peter Wyatt, 413, Oxford-street, W.
1892		Squires, Alfred James, Greenbank, Coroner's-lane, Farnworth, Widnes, Lancs.
1877		Stacey, Henry George, 300, High Holborn, W.C.
1899		Stainer, John Ward, 103, Cheriton-road, Folkestone
1879	Trans.	‖Stallard, George, M.A. (Oxon.), Horton-crescent, Rugby
1904		Stanger, Reginald Harry Hursthouse, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W.

Date of Election.		
1902		Stanger, William Charles South, Ambleside, Corder-road, Ipswich
1904		Stanley, Harry, B.Sc. (Lond.), A.I.C., The Merchant Venturers' Technical College, Bristol
1887		‖Stansell, Lionel William, F.I.C., 7, Albion-place, Maidstone, Kent
1895		‖Stansfield, Alfred, D.Sc. (Lond.), McGill University, Montreal, Canada
1902		Stansfield, Edgar, M.Sc. (Vict.), Macdonald Chemistry and Mining Building, McGill University, Montreal, Canada
1899		Stansfield, Samuel, B.Sc. (Vict.), 2, Park-road, Batley, Yorks.
1900	Trans.	Stapleton, Henry Ernest, Prof., B.A. and B.Sc. (Oxon.), Presidency College, Calcutta, India
1870		Starey, Arthur John, 39, Woodland-gardens, Highgate, N.
1870	Trans.	‖Stark, James Fleming, Rosedale, Bromborough, Cheshire
1906		Starling, William Robert Rigg, 23, Magdalen-road, Norwich
1902		Stead, Francis Bernard, Clifton College, Bristol
1896		Stead, John Christopher, 1, Finsbury-circus, E.C.
1882	Trans.	Stead, John Edward, F.R.S., F.I.C., 11, Queen's-terrace, Middlesbrough
1897		Steel, Frederick William, c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Australia
1885		Steel, Robert Elliot, County School, Northampton
1890		Steel, Thomas, c/o Colonial Sugar Refining Co., O'Connell-street, Sydney, N.S.W.
1900	Trans.	Steele, Bertram Dillon, D.Sc. (Melbourne), The University, Melbourne, Australia
1905		Steger, James, B.Sc. (Lond.), 111, Chesterfield-road, Bristol
1898		Steinhart, Oscar Julian, Ph.D. (Erlangen), c/o Messrs. Steinhart, Vogel and Cloud, Highfield Works, Feltham, S.O., Middlesex
1901		Stell, Samuel Fenton, 25, Henry-street, Keighley
1892	Trans.	‖Stenhouse, James, View-park-gardens, Bonnyrigg, Midlothian
1884		Stenhouse, Thomas, F.I.C., Townhead, Rochdale
1905		Stennitt, Sydney Dockeray, M.Sc. (Vict.), Holcroft, Edgeley-road, Whitchurch, Salop.
1895	Trans.	Stephens, Frank Robert, c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880		‖Stephens, Henry Charles, Cholderton, Salisbury
1897		Stephens, Michael Edmund, 57, Aldersgate-street, E.C.
1895		Stephenson, Herbert Frederick, A.R.C.S., Fairhaven, Lucien-road, Tooting Common, S.W.
1902		Stephenson, Robert, jun., M.A. (Cantab.), Burwell, Cambridge
1891	Trans.	Stephenson, Thomas, 137, George-street, Edinburgh
1888	Trans.	Stern, Arthur Landauer, D.Sc. (Lond.), F.I.C., Southbank, Stapenhill, Burton-on-Trent

Date of Election.			
1896			Steuart, Douglas Stuart Spens, B.Sc. (Vict.), The Royal Societies' Club, St. James's-street, S.W.
1903	Trans.		Steven, Alec Bowring, B.Sc. (Lond.), The University, Leeds
1905			Stevens, Edmund Henry, Haw House, Rothbury, Northumberland
1905			Stevens, Harold Blythen, 225, Oxford-street, W.
1897	Trans.		Stevens, Henry Potter, M.A. (Oxon.), Ph.D. (Heidelberg), F.I.C., 15, Borough, London Bridge, S.E.
1903			Stevens, Montague White, A.R.C.S., A.I.C., H.M. Patent Office, 25, Southampton-buildings, W.C.
1899			Stevenson, Arnold, B.A. (Cantab.), 4, Porchester-gardens, W.
1903	Trans.		Stevenson, Henry Edward, 155, Coventry-road, Ilford, Essex
1904			Stevenson, Henry Ernest, Avondale, Ditton Hill, Surrey
1864		C.1872-5 86-8.91-7 V.P. 1900-03	Stevenson, Sir Thomas, M.D. and F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1903	Trans.		Stewart, Alfred Walter, D.Sc. (Glas.), 53, Shaftesbury-road, Ravenscourt Park, W.; and 18, Annfield-terrace, Partickhill, Glasgow
1902			Stewart, Hector, Gulf Creek Copper Mine, via Barraba, N.S.W.
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, William Frederick Keating, F.I.C., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcs.
1887			Stocks, Herbert Birtwhistle, F.I.C., 12, Victoria-road, West Kirby, Cheshire
1894	Trans.		Stoddart, Frederick Wallis, F.I.C., Grafton Lodge, Sneyd-park, Bristol
1879	Proc.		‖Stokes, Alfred Walter, F.I.C., Town Hall, Paddington Green, W.
1873			‖Stone, Edward Daniel, Ackersley, Cheadle Hulme, near Stockport, Cheshire
1895			Stone, George, Esk Brewery, Launceston, Tasmania
1875			‖Stone, John Frederic Matthias Harris, M.A. (Cantab.), Barrister-at-Law, 3, Dr. Johnson's-buildings, Temple, E.C.
1879			‖Stone, William, M.A. (Cantab.), Oxford and Cambridge, Garrick, Bath, Union and Reform Clubs; and 63, Curzon-street, Mayfair, W.
1906			Storey, Francis Wylie, B.Sc. (Lond.), Government School, Bethlehem, Orange River Colony, S. Africa
1900			Storr, Bertram Vincent, B.Sc. (Vict.), 147, Coventry-road, Ilford, Essex

Date of Election.		
1887		‖Strangman, James Pim, Clydesdale-mansions, 9, Clydesdale-road, Notting Hill, W.
1904	Trans.	Streatfeild, Frederick Henry, 9, Crescent-road, South Tottenham, N.
1906		Streimer, Emanuel George, Park House, Margery-park-road, Forest Gate, E.
1900		Strong, Archie Hugh, 63, Herne-hill-road, Camberwell, S.E.
1904	Trans.	‖Struthers, Robert de Jersey Fleming-, M.A. and B.Sc. (Oxon.), Exeter College, Oxford
1885	Trans.	‖Stuart, Charles Maddock, M.A. (Cantab.), F.I.C., St. Dunstan's College, Catford, S.E.
1897	Trans.	Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1907		Sturrock, George Colleymore, Capt. R.A., Indian Cordite Factory, Aruvankad, Nilgiris, India
1890	Trans.	‖Sudborough, John Joseph, Prof., D.Sc. (Lond.), Ph.D. (Heidelberg), F.I.C., University College of Wales, Aberystwyth
1878	Trans.	‖Suguira, Shigetake, c/o Tokyo Chemical Society, Science College, Imperial University, Tokyo, Japan
1897		Sumner, Leonard, B.Sc. (Vict.), Butt Hill, Prestwich, near Manchester
1907		Sutcliffe, Samuel Mortimer, 4, Clive-place, Bradford
1904		Sutcliffe, Thomas, 1, Swires-road, Boulevard, Halifax, Yorks.
1887		‖Sutherland, David Alexander, F.I.C., 26, Victoria-street, Westminster, S.W.
1860		Sutton, Francis, F.I.C., Laboratory, Bank Plain, Norwich
1886		‖Sutton, Francis Napier, F.I.C., 6, Grosvenor-gardens, Cricklewood, N.W.
1902		Swain, James, 17, Winsham-street, West-side, Clapham Common, S.W.
1875		Swan, Sir Joseph Wilson, Hon. M.A. and Hon. D.Sc., (Dun.), F.R.S., F.I.C., 58, Holland-park, W.
1905		Swann, Robert Reed, B.Sc. (Dun.), The Lookout, Seaton Delaval, Northumberland
1894		‖Swinburne, James, F.R.S., 82, Victoria-street, S.W.
1891		Sykes, Matthew Carrington, M.D. (Dun.), F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. and D.P.H. (Lond.), Sykeshurst, Barnsley, Yorks.
1880		Symons, Brenton, Burwood, Warminster-road, South Norwood, S.E.
1874	Trans.	‖Symons, William Henry, M.D. (Brussels), D.P.H. (Oxon.), M.R.C.S. (Eng.), F.I.C., Health Office, Guildhall, Bath
1899	Trans.	Szarvasy, Charles Emerique, Ph.D. (Buda Pesth), Muegyetem VIII, Budapest, Hungary
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokyo, Japan

Date of Election.		
1887	Trans.	‖Takamine, Jokichi, 521, West 179th-street, New York, U.S.A.
1906		Talbot, George Stanley, c/o Pacific Phosphates Co., 68 Pitt-street, Sydney, N.S.W.
1901		Tankard, Arnold Rowsby, 82 Llanthewy Road, Newport, Mon.
1894		Tanner, Alfred Edward, Westminster Hospital, S.W.
1901		Tatam, George William Gerald, Cragleigh, Washwood-heath-road, Birmingham
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D. (Würzburg), F.I.C., Windsor Buildings, George-street, Liverpool
1884		‖Tate, Walter, Woodlands, Twerton-on-Avon, Bath
1890		Tate, William, Prof., Civil Engineering College, Sibpur, near Calcutta, India
1867		Tatlock, Robert Rattray, F.I.C., 11, Bellshaugh-road, Kelvinside West, Glasgow
1882		Taylor, Gotfred Midgley, Caxton House, Westminster, S.W.
1894		Taylor, Herbert John, 52, Alexandra-crescent, Dewsbury
1880		‖Taylor, James, B.Sc. (Manc.), A.R.S.M., Adderton, Dundas, N.S.W.
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John George, 3, Outram-street, Stockton-on-Tees
1905		Taylor, John William, University College, Reading
1874	Trans.	‖Taylor, Robert Llewellyn, F.I.C., 4, St. Werburgh's-road, Chorlton-cum-Hardy, Manchester
1901		Taylor, William Henry, B.Sc. (Lond.), F.I.C., 20, Balcaskie-road, Eltham Park, Kent
1878		‖Tcherniac, Joseph, Ph.D. (Zürich), c/o South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1907		Tebb, William Scott, M.A., M.D. and D.P.H. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), L.S.A., F.I.C., 1, Finsbury-circus, E.C.
1879	Trans.	‖Teed, Frank Litherland, D.Sc. (Lond.), F.I.C., 9, Mincing-lane, E.C.
1906		Telling, Harry George, Cooksbridge Brewery, Cooksbridge, Sussex
1906		Tempany, Harold Augustine, B.Sc. (Lond.), F.I.C., St. Johns, Antigua, British West Indies
1901		Templeman, William Henry, 67, Park-street, Spring Bank, Hull
1907		Templeton, William Sandilands, Prof., M.A. and B.Sc. (Glas.), Medical and Technical College, Colombo, Ceylon
1894		‖Terry, Edwin, 374, Brixton-road, S.W.
1881		Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893		Thackrah, James Robert, M.A. (Oxon.), Ph.D. (Leipzig), Technical Schools, Tavistock-road, Plymouth
1895		Theodosius, Alfred Fletcher, M.A. (Oxon.), University College, Oxford

Date of Election.			
1904			Thibault, Paul John, Howell, N.S.W.
1899			Thiersch, Harry Alexander, c/o British Resin Works, Ltd. Belvedere, S.O., Kent
1901			Thomas, Albert Edward, B.Sc. (Lond.), F.I.C., Boys' Middl School, Castle-street, Tiverton, Devon
1871			‖Thomas, Charles, J.P., Stoke Bishop, near Bristol
1905			Thomas, George Devenish, B.Sc. (Lond.), 18, Randolph-gardens Dover
1874			Thomas, Harry Edgecumbe, Rockleaze Point, Clifton, Bristol
1875	Trans.		‖Thomas, Joseph William, F.I.C., Overdale, 6, Kingswood-road Shortlands, Kent
1907	Trans.		Thomas, Richard Noel Garrod, B.A. (Oxon.), 25, Clytha-park Newport, Mon.
1877			‖Thompson, Beeby, 67, Victoria-road, Northampton
1904			Thompson, Charles Herbert, Harrington House, Amblecote Stourbridge
1886	Trans.		‖Thompson, Claude Metford, Prof., M.A. (Cantab.), D.Sc. (Lond.) University College ; and 38, Park-place, Cardiff
1894			Thompson, Edward Cumming, 32, Ulundi-road, Westcomb Park, S.E.
1893			Thompson, Frank Ernest, A.R.C.S., A.I.C., 51, Lichfield-road Walsall
1893			Thompson, George Roos, The Laboratory, 69, Dock-street Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1904			Thompson, Hubert, B.Sc. (Vict.), Agricultural College, Holme Chapel, Cheshire
1886			Thompson, William Phillips, 95, Shrewsbury-road, Claughton Birkenhead
1903			Thomson, George Malcolm, Newington, Dunedin, New Zealand
1872	Trans.	C. 1880-3, 1904-06 S. 1883-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., Hon. LL.D. (Glas.), F.R.S., F.I.C. King's College, Strand, W.C. ; and 9, Campden Hill-gardens, W
1899			Thomson, Robert Tatlock, F.I.C., 156, Bath-street, Glasgow
1872			Thomson, William, F.I.C., Royal Institution Laboratory, Manchester
1895			Thomson, William Thomas, Oxford-villas, Waltham Abbey
1906			Thorne, Emanuel Isaac, 13, Cantwell-road, Plumstead, S.E.
1882	Trans.		Thorne, Leonard Temple, Ph.D. (Würzburg), F.I.C., 2, Denbigh gardens, Richmond, Surrey
1906			Thornton, Percy Charles, Council School, Arnot-street, Walton, Liverpool
1906			Thorp, Arthur William, 210, Sherborne-road, Yeovil

Date of Election.			
1891			Thorp, Walter, B.Sc. (Lond.), F.I.C., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph.D. (Heidelberg), M.Sc. (Manc.), The University, Manchester
1871	Trans.	C. 1879-83 V.P. 1884-7 T. 1889-99 P. 1899-1901	†‖Thorpe, Thomas Edward, Prof., C.B., D.Sc. (Vict.), Sc.D. (Dub.), Ph.D. (Heidelberg), LL.D. (Glas.), F.R.S., Government Laboratory, Clement's Inn-passage, W.C.
1899			Threlfall, Richard, Prof., M.A. (Cantab.), F.R.S., Assoc. M. Inst. C.E., 30, George-road, Edgbaston, Birmingham
1880			Thwaite, Benjamin Howarth, 29, Great George-street, Westminster, S.W.
1897	Trans.		‖Tickle, Thomas, B.Sc. (Lond.), F.I.C., 83, Queen-street, Exeter
1902			Tidy, Henry Letheby, B.A. (Oxon.), 38, Clarence-gate-gardens, Regent's Park, N.W.
1903			Tighe, Arthur, Umberleigh, Cherry-road, Turramurra, near Sydney, N.S.W.
1903			Tilburn, Charles, c/o The Australian Explosives and Chemical Co., Ltd., Deer Park, Victoria, Australia
1865	Trans.	C. 1878-81 V.P. 85-8, 91-4, 96-9 T. 1899-03 P. 1903-05	‖Tilden, William Augustus, Prof., D.Sc. (Lond.), Hon. Sc.D. (Dub.), Hon. D.Sc. (Vict.), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.; and The Oaks, Northwood, S.O., Middlesex
1900			Tilley, James Walter, 95a, Southwark-street, S.E.
1905			Tillott, John Booty, 55, Wood-street, Westminster, S.W.
1902			Tindall, Arthur Lea Butler, M.A. (Cantab.), Dagnall, Bakewell
1904	Trans.		Tingle, Alfred, B.Sc. (Lond.), Ph.D. (Penn.), Chinanfu, Shantung, China
1889	Trans.		‖Tingle, John Bishop, Prof., Ph.D. (Munich), McMaster University, Toronto, Canada
1907	Trans.		Tinkler, Charles Kenneth, B.Sc. (Wales), The University, Edmund-street, Birmingham
1898			Tisdale, Charles William Walker, The Dairy, Northallerton, Yorks.
1905	Trans.		Titherley, Arthur Walsh, D.Sc. (Vict. and L'pool.), Ph.D. (Heidelberg), Southcot, Manor-hill, Upton, near Birkenhead
1907			Toch, Maximilian, 261, West 71st-street, New York, U.S.A.
1891			Tocher, James Fowler, F.I.C., 1, Chapel-street, Peterhead
1903			Tolson, Stanley, 248, Kingsbury-road, Birmingham
1884	Trans.		‖Tompson, Frederick William, Chemical Department, King's College, Strand, W.C.
1877			‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1904			Tong, Walter, Holmdene, Pole-lane, Failsworth, Manchester

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† Longstaff Medallist, 1881.

Date of Election.		
1904		Tonkin, Arnold Bertram, Government Laboratory, Durban, Natal, S. Africa
1906		Tonkin, Ronald William, 37, Oak-hill-road, Putney, S.W.
1907		Tonner, William Griffiths, B.Sc. (Wales), Spartan Villa, Queen Elizabeth-road, Kingston-on-Thames
1893		‖Towers, John William, Victoria-road, Widnes
1903		Toyne, Francis Digby, B.A. (Cantab.), 270, Spotland-bridge, Rochdale, Lancs.
1901		Tozer, Herbert Ackerman, B.A. (Lond.), Jesmond, Edith-road, Selhurst, S.E.
1887		‖Traphagen, Frank W., Prof., Ph.D. (New York), Colorado School of Mines, Golden, Colorado, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris William, Prof., D.Sc. (Lond.), F.R.S., Indian Institute of Science, Bangalore, India; and c/o Messrs. Jeremiah Lyon and Co., 4, Lombard-court, E.C.
1906		Treble, Richard Lumley, B.Sc. (Dun.), 2, Rectory-terrace, Gosforth, Newcastle-on-Tyne
1895		Treharne, Frederick Gwilym, Wrangbrook, Llanishen, near Cardiff
1888		‖Trewby, Herbert, 62, St. John-street, E.C.
1881		‖Trigger, Oliver, F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1902		Trimen, Stephen Herbert, Survey Dept., Finance Ministry, Giza, Egypt
1897		Tripp, Edward Howard, Ph.D. (Marburg), The Modern School Bedford
1905		Troye, Gustave Arthur, P.O. Box 2706, Johannesburg, S. Africa
1905	Trans.	Tuck, William Bradshaw, B.Sc. (Lond.), University College, Gower-street, W.C.
1898	Trans.	Tucker, Samuel Auchmuty, Ph.B. (Columbia), Columbia University, New York, U.S.A.
1889		Tucker, Willis Gaylord, M.D. (Albany), Ph.D. (Union Univ.), Medical College, Albany, New York, U.S.A.
1896		Tuckett, James Edwin Shum, M.A. (Cantab.), Marlborough College, Wilts.
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancs.
1902		Tunnicliffe, William Wright, B.Sc. (Lond.), Sunnyside, Newhall, Burton-on-Trent
1897	Trans.	Turnbull, Andrew, Ph.D. (Heidelberg), 3, Lord-street, Liverpool
1906		Turnbull, Robert Hutchison, F.I.C., c/o Messrs. MacAndrews and Forbes Co., 3rd-street and Jefferson-avenue, Camden, N.J., U.S.A.
1903		Turner, Arnold, 84, Molesworth-street, Rochdale
1886		Turner, Arthur, The Limes, Aylesbury

Date of Election.		
1896		Turner, Benjamin Bernard, B.Sc. (Lond.), Ph.D. (Göttingen), c/o Rev. F. Storrs Turner, Ivanhoe, Portland-road, East Grinstead, Sussex
1897		Turner, Basil William, Wood's-chambers, 5, Moore-street, Sydney, N.S.W.
1888	Trans.	Turner, Charles, 225A, Oxford-street, Manchester
1906		Turner, George Augustus, 12, The Foregate, Worcester
1897		Turner, John Scriven, 20, Bury-street, Bloomsbury, W.C.
1902		Turner, Lyon Viccars, Crescent Lodge, St. John's, S.E.
1883	Trans.	‖Turner, Thomas, Prof., M.Sc. (Vict.), A.R.S.M., F.I.C., The University, Edgbaston, Birmingham
1903	Trans.	Turner, William Ernest Stephen, M.Sc. (Birm.), B.Sc. (Lond.), The University, Sheffield
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab.), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robert, Albion House, The Marina, Deal
1905	Trans.	Tutin, Frank, 9, Haverfield-gardens, Kew, Surrey
1888	Trans.	Tutton, Alfred Edwin Howard, M.A. and D.Sc. (Oxon.), F.R.S., 41, Ladbroke-square, W.
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1907		Twiney, William George, B.Sc. (Lond.), St. Joseph's College Colombo, Ceylon
1904	Trans.	Twiss, Douglas Frank, M.Sc. (Birm.), A.I.C., The Municipal Technical School, Suffolk-street, Birmingham
1899	Trans.	Tyler, Ernest Albert, B.A. (Cantab.), 33, The Promenade, Mount Pleasant, Swansea
1876		Typke, Paul George William, F.I.C., Lawn House, New Malden, Surrey
1876		Tyrer, Thomas, F.I.C., Stirling Chemical Works, Abbey-lane, Stratford, E.
1903		Tyrrell, Dennis, 182, King-street, Norwich
1876		‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffs.
1865		Umney, Charles, F.I.C., 50, Southwark-street, S.E.
1893	Trans.	Umney, John Charles, 50, Southwark-street, S.E.
1889		‖Underhill, Thomas John, Stanley, Quernmore-road, Bromley, Kent
1904		Underhill, William Wood, 10, Hartham-road, Holloway, N.
1897		‖Unwalla, Rustomji Navroji, Medical Dept., Bhaunagar, Kathiawâr, India
1882		‖Vacher, Francis, F.R.C.S., and M.R.C.P. (Edin.), c/o Dr. Kenyon, Flookersbrook, Chester

Date of Election.			
1890			Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1903			Van Laer, Norbert, c/o Messrs. Truman, Hanbury, Buxton and Co., Ltd., Burton-on-Trent
1901			Varley, Harold Fay Fleetwood, Fernleigh, Morpeth, Northumberland
1883			Vasey, Samuel Archibald, F.I.C., Beechcroft, Burnt Ash-lane, Bromley, Kent
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor Herbert, M.A. and D.Sc. (Oxon.), F.R.S., 8, Marlborough-place, N.W.
1891			Velling, Frederick William de, B.A., Higher Grade Board School, The Boulevard, Hull
1881			Venable, Francis Preston, Ph.D. (Göttingen), Chapel Hill, North Carolina, U.S.A.
1887			‖ Vergara, Vargas José Maria, Apartado No. 237, Bogotá, Colombia
1901			Verteuil, Joseph de, Clarence-street, Port of Spain, Trinidad, British West Indies
1897			Viccajee, Framjee Khurshedjee, H.H. The Nizam's Mint, Hyderabad, Deccan, India
1884			‖ Voelcker, Edward William, A.R.S.M., F.I.C., 22, Tudor-street, Blackfriars, E.C.
1884		C 1891-5, 1902-04	‖ Voelcker, John Augustus, Hon. M.A. (Cantab.), Ph.D. (Giessen), B.A. and B.Sc. (Lond.), F.I.C., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖ Voss, Walter Arthur, Eastwood-road, Rayleigh, Essex
1885			Vulté, Hermann T., Ph.D., Columbia University, New York City, U.S.A.
1901			‖ Wade, Frank, A.R.C.S., F.I.C., 26, St. Ronan's-avenue, Southsea; and Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.	C. 1905-	‖ Wade, John, D.Sc. (Lond.), F.I.C., Hunstanton Lodge, Downe, Kent; and Guy's Hospital, London Bridge, S.E.
1903	Trans.		Wadmore, John Mello, M.A. (Oxon.), Aldenham School, near Elstree, Herts.
1901			Wager, Morton Ethelred, B.Sc. (Lond.), Holme Cottage, Mytholmroyd, S.O., Yorks.
1894			‖ Wagner, William George, Glyndhurst, Ealing Common, W.
1884			Wainwright, John Howard, Ph.D. (Columbia), Room 1210, 60, Wall-street, New York City, U.S.A.
1893			Wait, Charles E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			‖ Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada

Date of Election.			
1899			Walden, Allan Frederick, M.A. (Oxon.), 37, High-street, and New College, Oxford
1897			Walford, Samuel Matthew, Wyncote, Hatherlow, Stockport
1881			‖Walker, Archibald, M.A. (Oxon.), F.I.C., 7, Crown-terrace, Dowanhill, Glasgow
1898	Trans.		Walker, Andrew Jamieson, Ph.D. (Heidelberg), B.A. (Dub.), Municipal Technical College, Derby
1899			Walker, Charles, c/o T. B. Walker, Esq., School of Mines, Charters Towers, Queensland, Australia
1894	Trans.		Walker, Charles Henry Hirst, M.A. (Oxon.), Secondary School, Oldbury, Birmingham
1889			Walker, Daniel, School of Mines, Ballarat, Victoria, Australia
1906			Walker, Franklin Wilfred, 39, Graham-road, Acton-green, W.
1890	Trans.	C. 1899-04	‖Walker, James, Prof., D.Sc. (Edin.), Ph.D. (Leipzig), F.R.S., University College; and 8, Windsor-terrace, Dundee
1890			Walker, James Samuel Hourston, M.B., C.M., (Edin.), D.P.H. (Cantab.), Clinical Research Association, Watergate House, Adelphi, W.C.
1897	Trans.		Walker, James Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1865	Trans.		‖Walker, John Francis, M.A. (Cantab.), F.I.C., 45, Bootham, York; and Sidney Sussex College, Cambridge
1888			Walker, John Thom Ainslie, 64, Cannon-street, E.C.
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey, Manchester
1898			Walker, Samuel, M.A. and D.Sc. (Edin.), 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1903			Walker-Pole, Miles, 71, De Korle-street, Braamfontein, Johannesburg, S. Africa
1905			Wall, Francis Henry, 15, Barratt-street, Southport, Lancs.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, A.M. (Harvard), Ph.D. (Columbia), 7, Franklin-place, Morristown, N.J., U.S.A.
1904			Walling, Léon Edward, 43, Union-road, Rotherhithe, S.E.
1902			‖Wallis, Thomas Edward, B.Sc. (Lond.), F.I.C., 96, Stephens-road, Tunbridge Wells, Kent
1883			‖Walmsley, Robert Mullineux, D.Sc. (Lond.), Northampton Institute, St. John-street, Clerkenwell, E.C.; and 23, Hilldrop-road, Camden-road, N.
1905			Walpole, George Stanley, B.Sc. (Melbourne), Lister Institute of Preventive Medicine, Chelsea-gardens, S.W.
1888			Walrond, Edward Dalrymple, M.A. (Cantab.), North Eastern County School, Barnard Castle, Durham

Date of Election.		
1903		Walsh, Thomas Crosbie, Casilla 614, Antofagasta, Chile, S. America
1899		Walton, Robert Hawks, Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884		‖Walton, Thomas Utrick, B.Sc. (Glas.), F.I.C., Colonial Sugar Refining Co., Sydney, N.S.W.
1905		Want, William Phillip, 11, Pearfield-road, Forest Hill, S.E.
1864		Ward, George, F.I.C., Buckingham-terrace, Headingley, Leeds
1895		Ward, George John, Hallam Fields, Ilkeston, S.O., Derbyshire
1891		Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875		Wardle, Sir Thomas, Leek, Staffs.
1907		Warner, Charles Horne, 24, Gordon-street, Gordon-square, W.C.
1871		Warner, George Joseph, Halton Villa, Widnes
1906		Warren, Richard Alfred, Belle Vue, Hallow-road, Worcester
1888		Warrick, Frederic Walmsley, 6, Nile-street, City-road, N.
1895		Warrington, Thomas Cotterill, M.A. (Oxon.), 29, Stockwell-street, Leek, Staffs.
1906		Wasteneys, Hardolph, Board of Waterworks, Brisbane, Queensland, Australia
1882		Waterfall, Charles James, F.I.C., 4, Queen-square, Bristol
1901		‖Waterhouse, James, Major-General, I.S.C., Hurstmead, High-street, Eltham, Kent
1894		Waterhouse, Robert, 8, Severn-road, Sheffield
1907		Watkins, Charles Rowlatt, B.A. (Cantab.), Madras Club, Madras, India
1893		Watson, Alexander Forbes, B.Sc. (Edin.), F.I.C., Laboratory, Watling-street, Dublin
1885		‖Watson, Charles, c/o Messrs. Josiah Hardman, Ltd., Aston Church-road, Birmingham
1904	Trans.	Watson, Edwin Roy, B.A. (Cantab.), B.Sc. (Lond.), Civil Engineering College, Sibpur, Calcutta, India
1887		‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1899		Watson, Fred Sheasby, B.Sc. (Vict.), Sandgate, Villiers-road, Woodthorpe, Nottingham
1906		Watson, Frederick William, B.Sc. (Lond.), F.I.C., Consolidated Gold Fields of South Africa, Ltd., P.O. Box 108, Germiston, Transvaal, S. Africa
1904		Watson, Herbert Wood, B.Sc. (Vict.), c/o H. Hogarth, Esq., Denton Avenue, Gledhow, Leeds
1906		Watson, John Adam, 8, Powis-gardens, Notting Hill, W.
1883		‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1876	Trans.	‖Watson, William Henry, J.P., Braystones House, Beckermet, Cumberland

Date of Election.			
1877			Watt, Alexander, F.I.C., c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1904			Watt, Francis Langston, A.R.C.S., A.I.C., Russenden, Stanley, street, Epping, near Sydney, N.S.W.
1906			Watt, George Gordon, 26, Albert-square, Clapham-road, S.W.
1906			Watt, Henry Edgar, M.Sc. (Dun.), A.I.C., 35, Clarence-road, Sidcup, S.O., Kent
1883	Trans.		Watts, Hon. Francis, C.M.G., Hon. D.Sc. (Birm.), F.I.C., Government Laboratory for the Leeward Islands, Antigua, West Indies
1906			Watts, James Neill, P.O., Eikenhof, Johannesburg, S. Africa
1872	Trans.		‖Watts, John, M.A. (Oxon.), D.Sc. (Lond.), F.I.C., Merton College, Oxford
1878	Trans.		Watts, John Isaac, Beechfield, Hartford, Cheshire
1888			Way, Edward John, F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal, S. Africa
1901			Wayland, William Abraham, 12, Albert-road, St. John's, S.E.
1902			Webb, Arthur James, M.A. (Oxon.), B.Sc., 21, Hammelton-road, Bromley, Kent
1883	Trans.		Webster, Charles Stuart Stanford, F.I.C., Malvern House, Redland, Bristol
1866			Webster, George Watmough, 1, Grange-road, West Kirby, Birkenhead
1877			Webster, William, 50, The Park, Blackheath, S.E.
1906	Trans.		Wechsler, Elkan, Ph.D. (Würzburg), 59, Petherton-road, Canonbury, N.
1904			Weeks, Henry Bridges, F.I.C., The Retreat, Infield-park, Barrow-in-Furness
1904			Weinberg, John, Rosa Sugar Works and Distillery, Rosa United Provinces, India
1905			Weiskopf, Eric H., Dynamite Factory, Modderfontein, Transvaal, S. Africa
1903			Weiss, Carl Friederich Richard, M.A., Ph.D., (Bâle), 27A, St. Mary-at-hill, E.C.
1898			Weissmüller, Edward Charles, Hill Crest, The Heath, Runcorn
1901			Welch, George Edward, B.Sc. (Lond.), Grammar School, Wakefield
1888			Welch, John Cuthbert, Alaska Copper Co., Coppermount, Alaska, U.S.A.
1893			Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891			Wellington, Stephen Newcombe, Assoc.M.I.E.E., 97, Portsdown-road, Maida Vale, W.
1884	Trans.		Wells, James S. Chester, Ph.D. (Columbia), c/o Silver Fissure Mining Co., Polaris, Beaverhead Co., Montana, U.S.A.

Date of Election.		
1902		Wells, John William, M.D. and C.M. (Edin.), D.P.H. (Vict.), Springburn, Montague-street, Blackburn
1890		Wells, Sydney Russell, M.D. and B.Sc. (Lond.), M.R.C.S. (Eng.), M.R.C.P. (Lond.), 16, Lower Seymour-street, Portman-square, W.
1903		Welsford, Giles Haddon, Royal Gunpowder Factory, Waltham Abbey, Essex
1897		Welsh, John, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 43, Tarvin-road, Chester
1888	Trans.	Werner, Emil Alphonse, F.I.C., 5, Church-avenue, Rathmines, Dublin
1886		‖Wertheimer, Julius, Prof., B.A., B.Sc. (Lond.), F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, Charles Alfred, A.R.C.S., F.I.C., 95, Oakhill-road, East Putney, S.W.
1899		West, George Hardstaff, B.Sc. (Lond.), County School, Pembroke Dock
1902		West, Joseph, Bank House, Fenton, Stoke-on-Trent
1898		Weston, Frank Edwin, 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry Adolph, c/o Messrs. Parke, Davis and Co., P.O. Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence John de, 148, Jerningham-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc. (Lond.), 18, Nevilledale-terrace, Durham
1906		Wheaton, Harold Joseph, 21, Chesterton-road, Cambridge
1902		Wheeler, Edward J., Ph.D., 79, Chapel-street, Albany, N.Y., U.S.A.
1905		Wheeler, Ernest, c/o Messrs. Crossley Bros., Openshaw, Manchester
1894		Wheeler, Henry Lord, Ph.D. (Yale), The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest, 40, Gillott-road, Edgbaston, Birmingham
1897		Wheelwright, Edwin Whitfield, B.A. (Oxon.), Ph.D. (Munich), F.I.C., Greenholme, 24, Stanmore-road, Edgbaston, Birmingham
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford
1897		White, Arthur James, 243, Albert-road, Jarrow-on-Tyne
1893		White, Henry Clay, Prof., Ph.D. (Virginia), Hon. D.C.L. (Univ. South), Hon. LL.D. (Illinois), University, Athens, Georgia, U.S.A.
1891		White, Henry, 245, Western-road, Crookes, Sheffield
1899		White, Henry Fox, 52, Royal York-crescent, Clifton, Bristol
1905		White, John Ledger, D.Sc. (Dun.), 9, Sugden-road, Lavender Hill, S.W.

Date of Election.		
1889		‖White, John Tsawoo, M.A. (Calcutta), Pyinmana, Upper Burma, India
1905		White, John William, B.Sc. (Lond.), c/o The E.C. Powder Co., Green Street Green, Dartford
1897		White, Paul Thomas, Hortonfield House, West Drayton, Middlesex
1902		White, William Carter, Glenholme, Longlands-park-road, Sidcup, S.O., Kent
1893		White, William Gilchrist, Vicarage View, 133, Tottington-road, Bury, Lancs.
1885		Whitehead, Henry Hammond, Holland House, Spring-grove, Isleworth, W.
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, Philip Lewington, c/o W. H. Keys, Esq., Hall End Works, West Bromwich
1889		‖Whitehouse, William, Albany House, Bradmore, Wolverhampton
1904	Trans.	Whiteley, Charles Edward, 21, Brudenell-view, Leeds
1886	Proc.	‖Whiteley, Richard Lloyd, F.I.C., 5, Bagnall-street, West Bromwich
1892		Whiteside, John Lowe, 376, St. Helen's-road, Bolton
1863		‖Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, Christopher Joseph, West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, Ansdell, Lytham
1889		Whittam, Matthew, M.A. (Cantab.), 75, Creffield-road, West Acton, W.
1901		Whittle, James, 30, Bridge-street, Morpeth
1900		Wiechmann, Ferdinand Gerard, Ph.D. (Columbia), P.O. Box 79, Station W., Brooklyn, N.Y., U.S.A.
1906		Wiffen, Henry John, 17, Albany-road, Manor-park, E.
1889		Wigan, Basil Penwarne, Rhondda Valley Brewery Co., Treherbert, Pontypridd
1905		Wigginton, John Henry Becker, 7, Byfeld-gardens, Barnes, S.W.
1907		Wight, Robert Burt, M.A. (Cantab.), 3, Clarendon-terrace, Linthorpe-road, Middlesbrough
1906		Wightman, Charles, 43, Portland-place, W.
1896	Proc.	Wigner, John Harrison, Ph.D. (Heidelberg), 54, Keptie-street, Arbroath, N.B.
1896		Wilcox, Alfred James, Rev., Sycamore Farm, Morton, near Alfreton, Derbyshire
1891		‖Wild, John, B.Sc. (Vict.), A.I.C., Bredbury House, Bredbury, Stockport
1898		‖Wild, William Ernest, B.Sc. (Vict.), Alexander villas, Talbot-road, Glossop
1898		Wilder, Frederick Louis, Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans.	Wilderman, Meyer, Ph.D. (Freiburg), B.Sc. (Oxon.), Davy-Faraday Research Laboratory, Albemarle-street, W.

Date of Election.		
1881		Wilkes, John Potter, 54½, Old Broad-street, E.C.
1902	Trans.	Wilkinson, Edward John, 12, Mansfield-road, Manningham, Bradford
1904		Wilkinson, James Alfred, M.A. (Cantab.), Transvaal University College, P.O. Box 1176, Johannesburg, S. Africa
1903		Wilkinson, James Bates, M.D. and C.M. (Edin.), D.P.H. (Vict.), Town Hall, Oldham
1893		Wilkinson, John, Corporation Gas Works, Halifax
1905		Wilkinson, John Wells, M.A. (Wales), 50, Woolwich-road, Belvedere, S.O., Kent
1891		Will, Wilhelm, Prof., Ph.D. (Berlin), Colonie Grunewald, Boothstrasse 32, bei Berlin, Germany
1904	Proc.	Willcox, William Henry, M.D., B.Sc., M.R.C.P. and L.S.A. (Lond.), D.P.H. (Eng.), F.I.C., St. Mary's Hospital, Paddington, W.
1906		Willett, Herbert William Mills, The Cedars, Chislehurst, Kent
1905		Williams, Alan Herbert, 100, Church-road, Urmston, Lancs.
1862	Trans.	‖Williams, Charles Hanson Greville, F.R.S., Bay Cottage, Smallfields, near Horley, Surrey
1903		Williams, David John, Bath and West of England College of Chemistry and Pharmacy, 6, Cleveland-place, East Bath
1895		Williams, Evan, Bradford-road Gas Works, Manchester
1905		Williams, Gerard William, c/o The Ida H. Gold Mining Co., viâ Laverton, Western Australia
1892		Williams, John, Government Laboratory, British Guiana
1883	Proc.	Williams, Rowland, F.I.C., Hale Cote, Albert-park, Lancaster
1891		Williams, Seward Whiting, c/o Messrs. Seabury and Johnson, East Orange, New Jersey, U.S.A.
1872		‖Williams, Thomas, Chemical Laboratory and Assay Office, 8, Victoria-street, Liverpool
1885	Trans.	‖Williams, Walter Collingwood, B.Sc. (Lond.), F.I.C., 68, Grove-street, Liverpool
1892		Williams, William, M.A., M.D., B.Ch., and D.P.H. (Oxon.), M.R.C.S. (Eng.), County Health Department, 9, The Parade, Cardiff; and Brym Derw, Victoria-road, Penarth
1899	Proc.	Williams, William Arthur, 36, Woodburn-terrace, Edinburgh
1874	Trans.	‖Williams, William Carleton, B.Sc. (Vict.), F.I.C., Broomgrove, Goring-on-Thames, Reading
1907		Williams, William Henry, Government Education Department, Hong Kong, China
1898		Williamson, John Alexander, 66, Onslow-gardens, Muswell Hill, N.
1874	Trans.	‖Williamson, Robert, F.I.C., Messrs. Williamson and Corder, Ltd., Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Ph.D. (Munich), F.I.C., c/o The Cooper Research Laboratory, Berkhamsted, Herts.

Date of Election.		
1898		Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1896		Wills, Edward Chaning, M.A. (Cantab.), Rockstone, near Dawlish, S. Devon
1872		Wills, Joseph Lainson, 133, Midwood-street, Flatbush, Brooklyn, N.Y., U.S.A.
1906		Willstaetter, Richard, Prof., Ph.D. (Munich), Bergstrasse 25, Zürich V, Switzerland
1892	Trans.	Wilsmore, Norman Thomas Mortimer, B.Sc. (Melbourne), 126, Walm-lane, Willesden Green, N.W.
1885		Wilson, Alfred Charles, F.R.S.E., Borough Hall, Stockton-on-Tees
1879		‖Wilson, Charles Joseph, F.I.C., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, M.A. (Glas.), D.Sc., Carbeth, Killearn, Glasgow
1901		‖Wilson, Duncan, Broadwater Cross, Tunbridge Wells
1899	Proc.	Wilson, Frederick Robert Leyland, M.A. (Oxon.), Charterhouse, Godalming
1895		Wilson, Harry, F.I.C., 146, High-street, Southampton
1875		‖Wilson, James, M.A. (Dub.), Barrister-at-Law, 2, Essex-court, Temple; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, F.I.C., 17, Cardigan-road, Richmond Hill, Surrey
1890		Wilson, James Mitchell, M.D. and C.M. (Glas.), D.P.H. (Cantab.), County Hall, Beverley
1901		Wilson, James Scott, M.D. and C.M. (Glas.), D.P.H. (Cantab.), Bradford-street, Walsall
1895	Proc.	Wilson, John, M.Sc. (Vict.), Battersea Polytechnic, S.W.
1899		Wilson, John, 153, Buckley-street, Footscray, Victoria, N.S.W.
1902		Wilson, Lyndon Charles, 31, Castle-gate, Newark-on-Trent
1900	Proc.	Wilson, Leonard Philip, Oakland, Station-street-east, Coventry
1871		‖Wilson, William John, c/o Dr. W. M. Watts, Shirley, Venner-road, Sydenham, S.E.
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich, E.
1893		Winder, Edward Humphreys, Wetmore, Craven Arms, S.O., Salop
1894		Wingate, Hamilton More, B.Sc. (Glas.), 90, Queenswood-road, Forest Hill, S.E.
1895		Wingfield, Thomas Rowland, 5, Bromwich-street, Bolton
1876		Winser, Percy James, F.I.C., Moor House, Biddulph Moor, Congleton
1906		Winther, Chr., M.Sc., Ostervold 5, Copenhagen, Denmark
1898	Trans.	Witham, Ernest, B.A., B.Sc. (Lond.), The Grammar School, Rotherham

Date of Election.		
1876	Trans.	‖Witt, Otto Nikolaus, Geh. Rath Prof., Ph.D., Ebereschenallee 10, Westend bei Berlin, Germany
1906		Wolfe, Ernest Edwin, Kinsale, Co. Cork, Ireland
1896		Wolfenden, John Henry, B.Sc. (Lond.), 13, Pole-lane, Failsworth, Manchester
1907		Wolff, Mark Arthur, c/o Bank of Tarapaca and Argentina, Antofagasta, Chile, S. America
1902		Womersley, Charles Edward, 7, Tidswell-street, Heckmondwike, S.O., Yorks.
1889		Wood, Charles, Rossemount, Emm-lane, Heaton, Bradford
1860	Trans.	‖Wood, Charles Henry, F.I.C., Erica, Bournemouth-road, Parkstone, S.O., Dorset
1902		Wood, Frank Stanley, Chin Chu, Heathcote-street, Newland, Hull
1898	Trans.	Wood, Thomas Barlow, Prof., M.A. (Cantab.), Gonville and Caius College, Cambridge
1903		‖Wood, William Francis John, B.Sc. (Lond.), Hazelhurst, Doncaster-road, Barnsley
1884	Proc.	Wood, William Henry, B.A. (Oxon.), La Martinière, Calcutta
1900		Woodbridge, Walter Bourne, A.C.G.I., 13, Victoria-road, Shoreham, Sussex
1871	Trans.	Woodcock, Reginald C., F.I.C., The Sanitas Co., Ltd., Locksley-street, Limehouse, E.C.
1904		Woodcock, William Henry, 10, Chesson-road, W. Kensington, W.
1898		Woodhead, Samuel Allinson, B.Sc. (Dun.), F.I.C., Agricultural College, Uckfield, Sussex
1892		‖Woods, Hugh, B.A., M.D. and B.Ch. (Dub.), D.P.H., (R.C.P.S.I.), 31, Craven-street, Strand, W.C.
1888		Woodward, James, B.A., B.Sc. (Lond.), F.I.C., Drummond House, 31, Coventry-road, Ilford, Essex
1889		Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1903		Woolhouse, Sidney Herbert, M.A. and B.Sc. (Dub.), A.R.C.S.I., 2, Durham-road, Lower Edmonton, N.
1889		Woosnam, Richard William, F.I.C., 1, The Chase, Warby Mount, Brentwood, Essex
1903		Worden, Edward Chancey, M.A. (N.Y.), Clark Thread Co., Newark, New Jersey, U.S.A.
1884		‖Worrall, Jason Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858		‖Worsley, Philip John, Rodney Lodge, Clifton, Bristol
1906		Wortley, Edward Jocelyn, Rectory, Half-way-tree, Jamaica
1906	Trans.	Wren, Henry, M.A. (Oxon.), B.Sc. (Lond.), Ph.D. (Tubingen), 22, Stapleton-hall-road, Stroud Green, N.
1905		Wren, William James, A.R.C.S., Hilton College, near Maritzburg, Natal, S. Africa
1898		Wrench, Charles Arthur, 95A, Southwark-street, S.E.

Date of Election.			
1903			Wright, Fred., c/o Messrs. Elliott Bros., O'Connell-street, Sydney, N.S.W.
1895			Wright, Harold Edward, c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1878	Trans.		Wright, Lewis Thompson, 10, Linden-gardens, Bayswater, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		‖Wright, William Thomas, 11, Rundle-road, Sheffield
1864			‖Wrightson, John, Prof., College of Agriculture, Downton, Salisbury
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, William Fitzthomas, Wheatley-street, Coventry
1885	Trans.	C. 1892-6, S. 1898-99, 1903-05, V.-P 1905.	‖Wynne, William Palmer, Prof., D.Sc. (Lond.), F.R.S., F.I.C., A.R.C.S., The University; and 17, Taptonville-road, Sheffield
1906			Yates, John William, B.Sc. (Lond.), A.R.C.S., 71, North-street, Hugglescote, near Leicester
1903			Yeomans, Williams Wade, New Hey-road, Salendine-nook, Huddersfield
1886	Trans.		Yoshida, Hikorokurō, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred Collett, 17, Vicar's-hill, Lewisham, S.E.
1903			Young, Andrew, M.A. and B.Sc. (Edin.), Geological Department, South African College; and 5, Rosmead-avenue, Cape Town, S. Africa
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, Francis Samuel, M.A. (Oxon.), F.I.C., The College, Bishop's Stortford
1877			‖Young, Frank Watson, F.R.S.E., 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D. (Erlangen), 83, Harvard-court-mansions, Honeybourne-road, West Hampstead, N.W.
1895			Young, Henry Stow, F.I.C., c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 12, Edge-hill, Plumstead, Kent
1874			Young, John, 164, Bath-street, Glasgow
1898			Young, John Henry, B.Sc. (Vict.), c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1877			‖Young, John Rymer, 21, Palmyra-square, Warrington
1887	Trans.		Young, John William, B.A. and B.Sc. (Lond.), 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc. (Lond.), B.Sc. (Manc.), Hon. Sc.D. (Dub.), F.R.S., F.I.C., Trinity College, Dublin

Date of Election.		
1902		Young, Thomas Arthur, 11, Hampshire-street, Cheetham, Manchester
1907		Young, Walter Ormston, 14, Normanton-terrace, Newcastle-on-Tyne
1873		‖Young, William Charles, F.I.C., 2, Queen Anne's-grove, Bedford Park, W. ; and Chemical Laboratory, 19/20, Aldgate, E.C.
1907	Trans.	Zortman, Israel Hyman, B.Sc. (Vict.), Sternwartenstr., 12 IIr, Leipzig, Germany

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NUMBER OF HONORARY AND FOREIGN MEMBERS ...	29
,, ,, FELLOWS	2898

Richard Clay and Sons, Limited,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XXIV. Nos. 335—349.
JANUARY—DECEMBER, 1908.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1909.

Richard Clay and Sons, Limited,
bread street hill, e.c., and
bungay, suffolk.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR 1908.

£18 to H. Bassett, jun.: formation of tricalcium and tetracalcium phosphates.

£15 to G. D. Bengough: measurement of the rate of change in solid alloys.

£10 to J. C. Cain: preparation of substituted nitrosoacetylamino-compounds of the aromatic series. Constitution of santalin.

£10 to R. M. Caven and H. J. S. Sand: determination of the decomposition-temperature curves of the alkali bicarbonates.

£15 to F. D. Chattaway: action of halogens on urea, substituted ureas, and guanidine.

£5 to A. Clayton: preparation and constitution of coumarinic acid.

£5 to J. B. Cohen: relation of position isomerism to optical activity.

£5 to C. H. Desch: process of diffusion in solid solutions.

£5 to A. E. Dunstan: relation between viscosity and chemical constitution (continued).

£7 to K. Fisher: constitution of alkaloid cryptopin.

£5 to J. A. N. Friend: action of steam on red-hot iron.

£5 to N. L. Gebhard: reactions of hydroxylamines and aromatic diazo-compounds.

£20 to C. Gilling: hydroaromatic ketones.

£20 to A. G. Green: constitution of synthetic colouring matters (continued).

£7 to P. Haas: dimethyldihydroresorcin, and its nitrogen derivatives (continued).

£5 to H. B. Hartley: preparation of "pure water," and determination of the conductivity of dilute solutions of acids in it.

£7 to W. N. Haworth: condensations with ethyl cyanoacetate (continued).

£5 to G. S. Hibbert: reduction of hydroxy-ortho-toluic acid.

£10 to T. P. Hilditch: influence of unsaturated groups in the molecule on the rotatory power of optically active compounds.

£5 to Miss A. Homer: preparation of dinaphthanthracene. The action of aluminium chloride on benzene and toluene.

£5 to E. Hope: condensations with ethyl β-bromomethylmalonate.

£10 to T. M. Lowry: studies in dynamic isomerism (continued).

£10 to A. McKenzie: investigation of the Walden inversion.

£7 to A. N. Meldrum: reduction of hydroxy-meta-toluic acid (continued).

£10 to G. T. Morgan: influence of substitution on the tinctorial properties of azo-dyes and allied colouring matters.

£10 to T. S. Patterson: rotation of active compounds of aliphatic nitro-derivatives. Isomerism in the thiocyanates and *iso*thiocyanates.

£5 to W. H. Patterson: nature of occluded hydrogen.

£8 to F. M. Perkin: electrolytic and other oxidations of organic compounds. Condensations by means of calcium ethoxide.

£10 to R. H. Pickard and J. Yates: constitution of cholesterol (continued).

£5 to R. H. Pickard: isomerides of natural *l*-menthol.

£5 to F. G. Pope: relation between colour and constitution in the azomethine series.

£8 to T. S. Price: preparation of disulphides and diselenides (continued).

£5 to S. M. Revington and I. G. Rankin: sulphides and oxysulphides of silicon.

£10 to R. Robinson: synthesis of papaverine; and investigation of pyranol salts.

£10 to J. L. Simonsen: formation and properties of the *cyclo*butane ring. Attempt to synthesise norpinic acid. Action of chloromethyl ether on ethyl acetoacetate (continued).

£10 to Miss I. Smedley: refractive indices of unsaturated compounds.

£10 to S. Smiles: some thio-compounds.

£5 to R. Storey: resolution of methyltetrahydrobenzoic acid into its optically active modifications.

£10 to J. J. Sudborough: "Steric Hindrance," and polynitro-compounds (continued).

£10 to W. B. Tuck: absorption spectra of nitrosophenols and nitrosonaphthols, and of substituted azo-compounds. The relation of absorption spectra of nitrophenols.

£3 to C. H. Warner: investigation of nitrophthalic acids.

£8 to H. Wren: preparation of optically active ketols and their derivatives.

£10 to G. Young: heterocyclic compounds (continued).

Total amount granted during 1908 = £368.

LIST OF FELLOWS ELECTED DURING 1908.

Name.	Proposed.	Elected.
Akers, Noel Charles	October 22nd, 1908	December 3rd.
Allen, Thomas Boles	November 19th, 1908.	,, ,,
Allmand, Arthur John	February 6th, 1908	May 7th.
Andreae, Edward Philip	December 5th, 1907	February 20th.
Aubertin, Thomas	June 4th, 1908	December 3rd.
Ba, Maung	November 19th, 1908.	,, ,,
Baker, Thomas James	November 5th, 1908.	,, ,,
Baker, William Henry Benson	February 6th, 1908	May 7th.
Ballantyne, William Henry	May 21st, 1908	June 18th.
Barr, Guy	December 19th, 1907.	February 20th.
Barrett, Maurice	October 22nd, 1908	December 3rd.
Barton, Robert, jun.	January 16th, 1908	February 20th.
Bevan, Edward Morris	May 21st, 1908	June 18th.
Bhunsri, Prince Mom Chow	November 19th, 1908.	December 3rd.
Bickerstaffe, Robert	October 22nd, 1908	,, ,,
Birch, William Colet	June 18th, 1908	,, ,,
Blyther, Donald Francis	April 2nd, 1908	June 18th.
Bowen, Josiah Leonard	February 6th, 1908	May 7th.
Brakes, William Sudderick	October 22nd, 1908	December 3rd.
Braun, Marie Joseph Arsène	December 5th, 1907	February 20th.
Brown, Harry James	January 16th, 1908	,, ,,
Brown, James	May 21st, 1908	June 18th.
Brown, Walter, jun.	December 19th, 1907.	February 20th.
Carpenter, John Arthur	November 21st, 1907.	February 20th.
Clarke, Hans Thacher	January 16th, 1908	,, ,,
Clement, Leonard	October 22nd, 1908	December 3rd.
Collens, Archibald Edgar	December 19th, 1907.	February 20th.
Collier, William Henry	December 5th, 1907	,, ,,
Cooper, Charles Duncan	May 7th, 1908	June 18th.
Coverdale, Arthur Edward	March 5th, 1908	May 7th.
Cowburn, John Robert	May 7th, 1908	June 18th.
Cowley, Robert Charles	October 22nd, 1908	December 3rd.
Crichton, David Cowan	December 19th, 1907.	February 20th.
Dickinson, Cyril	November 21st, 1907.	,, ,,
Duckworth, Hugh Cecil	October 22nd, 1908	December 3rd.
Dunnicliff, Horace Barratt	,, ,, ,,	,, ,,
Dutt, Bidhu Bhushan	February 20th, 1908	May 7th.
Eagles, Edwin Mortimer	November 21st, 1907.	February 20th.
Easton, Reginald Freeman	October 22nd, 1908	December 3rd.
Everitt, Charles	November 5th, 1908.	,, ,,
Fairburn, Henry	October 22nd, 1908	,, ,,
Fairweather, James Hill	May 21st, 1908	June 18th.

Name.	Proposed.	Elected.
Falk, Kaufman George	May 7th, 1908	June 18th.
Findley, Albert Edward	February 20th, 1908.	May 7th.
Francies, Joseph Valentine	January 16th, 1908	February 20th.
Gale, Robert Cecil	November 21st, 1907.	,, ,,
Gãnguli, Atul Chandra	February 20th, 1907.	May 7th.
Gilling, Charles	February 6th, 1908	,, ,,
Girvan, Arthur Frank	October 22nd, 1908	December 3rd.
Green, Henry Hamilton	November 5th, 1908.	,, ,,
Green, Leonard Clifford	March 19th, 1908	May 7th.
Griffin, John	June 18th, 1908	December 3rd.
Hall, William	March 19th, 1908	May 7th.
Hebron, John Henry Albert	October 22nd, 1908	December 3rd.
Heron, John Maxwell	December 5th, 1907.	February 20th.
Hilditch, Thomas Percy	,, ,, ,,	,, ,,
Hinds, Cyril Arden	April 2nd, 1908	May 7th.
Hinks, Edward	November 5th, 1908.	December 3rd.
Holden, George Edward	February 20th, 1908.	May 7th.
Holland, Frank William Crossley-	May 21st, 1908	June 18th.
Holland, Norman	May 7th, 1908	,, ,,
Hornby, Percy Holme	February 20th, 1908.	May 7th.
Horrobin, Arthur	,, ,, ,,	,, ,,
Hughes, Joseph Albert	June 18th, 1908	December 3rd.
Hull, Thomas Ernest	,, ,, ,,	,, ,,
Hutchinson, Henry Brougham	April 2nd, 1908	June 18th.
Irvine, James Colquhoun	June 18th, 1908	December 3rd.
Johnson, Grove	October 22nd, 1908	,, ,,
Keiller, Patrick Anderson	,, ,, ,,	,, ,,
Kenyon, Joseph	November 5th, 1908.	,, ,,
King, James Kirkman	May 7th, 1908	June 18th.
Kohn, Hugo Stefan	March 19th, 1908	May 7th.
Krishnayya, H. V.	June 18th, 1908	December 3rd.
Larmuth, Lionel Gordon	May 7th, 1908	June 18th.
Linch, Frank William	October 22nd, 1908	December 3rd.
Lindley, Arthur Stanley	,, ,, ,,	,, ,,
Lyell, Henry Robert	May 7th, 1908	June 18th.
Lynch, Gerald Roche	March 19th, 1908	May 7th.
MacGregor, Gregor	November 5th, 1908.	December 3rd.
Mansfield, Herbert	February 20th, 1908.	May 7th.
Maywald, Frederick J.	March 5th, 1908	,, ,,
Meade, Alwyne Harcourt	February 6th, 1908	,, ,,
Meggitt, Alfred Ash	May 21st, 1908	June 18th.
Melling, Samuel Ernest	March 5th, 1908	May 7th.
Menzies, Frederick Nartin Kay	June 18th, 1908	December 3rd.
Merrick, Arnold	January 16th, 1908	February 20th.
Miles, William Herbert	November 5th, 1908.	December 3rd.
Millar, Charles James	,, ,, ,,	,, ,,
Minett, Edward Pigott	October 22nd, 1908	,, ,,
Morgan, Howard Houlston	June 18th, 1908	,, ,,
Morewood, Capel Darcy	December 5th, 1907.	February 20th.

Name.	Proposed.	Elected.
Neech, Herbert Richard	February 6th, 1908	May 7th.
Neogi, Panchānan	February 20th, 1908	,, ,,
Norman, Cyril Lawrence	October 22nd, 1908	December 3rd.
Normand, Alexander Robert	,, ,, ,,	,, ,,
Oke, Alfred William	December 5th, 1907	February 20th.
Okell, Stanley Allen Warrington	April 2nd, 1908	June 18th.
Pearson, George Edward	November 5th, 1908.	December 3rd.
Pearson, John William	June 4th, 1908	,, ,,
Perry, Frank	,, ,, ,,	,, ,,
Phillips, Thomas Richards	February 6th, 1908	May 7th.
Pingriff, George Neville	November 21st, 1907.	February 20th.
Pinnock, Douglas Robert	December 5th, 1907	,, ,,
Power, George O'Brien	June 4th, 1908	December 3rd.
Ray, Haradhan	May 7th, 1908	June 18th.
Readwin, William	,, ,, ,,	,, ,,
Rennie, Alexander	October 22nd, 1908	December 3rd.
Rhead, Ezra Lobb	,, ,, ,,	,, ,,
Richards, Francis Edward	February 6th, 1908	May 7th.
Roach, William Frothingham	June 4th, 1908	December 3rd.
Runeckles, Arthur Robert	December 5th, 1907	February 20th.
Rutter, Clement Thomas	May 21st, 1908	June 18th.
Salamon, Maurice Salamon	October 22nd, 1908	December 3rd.
San, Maung U.	November 19th, 1908	,, ,,
Saunderson, William	October 22nd, 1908	,, ,,
Scott, Andrew L.	December 19th, 1907.	February 20th.
Seelhorst, William	April 2nd, 1908	May 7th.
Shaw, William Bayliss	November 21st, 1907.	February 20th.
Shilstone, Herbert M.	November 19th, 1908.	December 3rd.
Singh, Puran	December 19th, 1907.	February 20th.
Smythe, John Armstrong	,, ,, ,,	,, ,,
Sommerfeldt, Ernst	October 22nd, 1908	December 3rd.
Southcombe, James Edward	May 21st, 1908	June 18th.
Speed, John Day	April 2nd, 1908	,, ,,
Spiers, Charles Sedgley	December 19th, 1907	February 20th.
Stead, Arthur	January 16th, 1908	,, ,,
Stewart, Alexander Mackintosh	May 7th, 1908	June 18th.
Stokes, Edward	May 21st, 1908	,, ,,
Tate, Francis George Henry	October 22nd, 1908	December 3rd.
Thomas, Frank Moreton	November 5th, 1908.	,, ,,
Trechmann, Adolph Octavius	December 5th, 1907	February 20th.
Tyson, Thomas Marshall	January 16th, 1908	,, ,,
Unwin, Harry Jackson	November 21st, 1907.	,, ,,
Vidyant, Hari Prasad	May 21st, 1908	June 18th
Wade, Alfred	December 5th, 1907	February 20th.
Walker, Herbert	November 21st, 1907.	,, ,,
Walton, Sidney Gilbert	November 5th, 1908.	December 3rd.
Ward, Herbert Horace	May 7th, 1908	June 18th.
Watkins, Edwin John	March 5th, 1908	May 7th.

Name.	Proposed.	Elected.
Watson, Herbert Edmeston	December 5th, 1907.	February 20th.
Watson, John	December 19th, 1907.	,, ,,
Watt, John	November 19th, 1908.	December 3rd.
Watt, Robert Dickie	October 22nd, 1908.	,, ,,
Weighell, Arthur	,, ,, ,,	,, ,,
Wheatley, William	February 6th, 1908.	May 7th.
Williams, David Thomas	January 16th, 1908.	February 20th.
Williams, Joseph Henry	November 21st, 1907.	,, ,,
Williams, Frederick	October 22nd, 1908.	December 3rd.
Wilson, Harry Percy	December 5th, 1907.	February 20th.
Winterson, William George	October 22nd, 1908.	December 3rd.
Withey, William Henry	December 19th, 1907.	February 20th.
Wood, Francis Charles Benjamin	January 16th, 1908.	,, ,,
Wootton, William Ord	November 5th, 1908.	December 3rd.
Worley, Frederick Palliser	,, ,, ,,	,, ,,
Wright, Allister MacLean	October 22nd, 1908.	,, ,,
Wright, Charles Harold	May 7th, 1908.	June 18th.
Yates, Harry James	May 21st, 1908.	,, ,,
Yates, Joseph	December 19th, 1907.	February 20th.
Young, Charles Robert	May 7th, 1908.	June 18th.

HONORARY AND FOREIGN MEMBERS ELECTED DURING 1908.

Name.	Proposed.	Elected.
Le Bel, Joseph Achille	January 16th, 1908.	February 6th.
Le Chatelier, Henry Louis	,, ,, ,,	,, ,,
Gautier, Armand Emile Justin	,, ,, ,,	,, ,,
Haller, Albin	,, ,, ,,	,, ,,
Hittorf, Johann Wilhelm	,, ,, ,,	,, ,,
Richards, Theodore William	,, ,, ,,	,, ,,
Wallach, Otto	,, ,, ,,	,, ,,

FELLOWS DECEASED, 1908.

Name.	Elected.	Died.
Ball, James Handby	June 18th, 1902	September 10th, 1908.
Banner, Samuel	February 2nd, 1888	January 11th, 1908.
*Becquerel, Antoine Henri	May 18th, 1904	August 25th, 1908.
Brough, Bennett Hooper	January 17th, 1884	October 3rd, 1908.
Cart, John Trevor	February 21st, 1907	September 5th, 1908.
Cunnington, Alfred Valentine	December 1st, 1898	October 8th, 1908.
Deck, Arthur	December 3rd, 1874	September 3rd, 1908.
Evans, Sir John	June 16th, 1876	May 31st, 1908.
Fasnacht, Eugène Arthur	February 19th, 1902	February 1st, 1908.
Friswell, Richard John	February 2nd, 1871	February 6th, 1908.
Gamble, Sir Josias Christopher	April 6th, 1876	September 24th, 1908.
Gerard, Thomas Alfred	June 15th, 1904	June 14th, 1907.
*Gibbs, Wolcott	May 3rd, 1866	December 9th, 1908.
Habirshaw, William Martin	June 4th, 1874	
Harland, Robert Henry	June 1st, 1876	November 25th, 1908.
Hart, Frederick William	January 21st, 1869	March 13th, 1908.
Helms, Albert	December 6th, 1894	May 28th, 1907.
Houldershaw, Arthur	February 7th, 1901	May 2nd, 1908.
Jackson, Raynsford Valentine	December 15th, 1881	November 3rd, 1908.
Johnson, John Grove	May 16th, 1872	March 18th, 1908.
Jowett, William Hall	February 21st, 1891	September 23rd, 1908.
Leeds, Frank Henley	June 18th, 1891	April 30th, 1908.
Morson, Thomas	December 15th, 1851	February 5th, 1908.
Pendlebury, Harold Lawson	July 5th, 1907	March 31st, 1908.
Player, Jacob Hort	November 15th, 1860	February 24th, 1908.
Shenstone, William Arthur	February 17th, 1876	February 3rd, 1908.
Sibson, Alfred	December 15th, 1859	December 31st, 1908.
Smith, Frank Gurney	December 3rd, 1903	February 17th, 1908.
Sonstadt, Edward	December 17th, 1874	July 5th, 1908.
Stevenson, Sir Thomas	February 18th, 1864	July 27th, 1908.
Thwaite, Benjamin Howarth	December 2nd, 1880	May 2nd, 1908.
Wade, Alfred	February 20th, 1908	March 17th, 1908.
Walker, Thomas Hatfield	April 17th, 1879	February 27th, 1907.

* Honorary and Foreign Member.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1908.

	Page in Proceedings.	Page in Transactions.
January 16th.		
1. Colour and constitution of azo-compounds. Part II. The salts of *p*-hydroxyazo-compounds with mineral acids. By John Jacob Fox and John Theodore Hewitt	6	333
2. A new method of determining vapour densities. Part I. By Philip Blackman	8	—
3. Studies in the camphane series. Part XXV. Action of diazomethane on the two modifications of *iso*-nitrosocamphor. By Martin Onslow Forster and Henry Holmes	8	242
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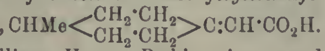
129. Experiments on the synthesis of 1-methyl*cyclo*hexylidene-4-acetic acid,  $CHMe<\begin{smallmatrix}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{smallmatrix}>C:CH\cdot CO_2H$. Part I. By William Henry Perkin, jun., and William Jackson Pope	145	1075
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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 335.

Thursday, January 16th, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Messrs. F. Buckney, J. E. L. Moore, W. H. Nuttall, and D. Willott were formally admitted Fellows of the Society.

The President announced that the Council had recommended the following gentlemen as Honorary and Foreign Members to be balloted for at the next meeting of the Society: Messrs. J. A. Le Bel, H. L. Le Chatelier, A. E. J. Gautier, A. Haller, J. W. Hittorf, T. W. Richards, and O. Wallach.

Certificates were read for the first time in favour of Messrs.:

Robert Barton, jun., 48, Wellclose Mount, Leeds.
Harry James Brown, Pembrey Lead Works, Burry Port.
Hans Thacher Clarke, Gayton Corner, Harrow.
Arnold Merrick, 66, Rothbury Terrace, Newcastle-on-Tyne.
Arthur Stead, B.Sc., 113a, Kellner Street, Bloemfontein, O.R.C.
Thomas Marshall Tyson, 2, Osborne Road, Forest Gate, E.
David Thomas Williams, 9, Calvert Terrace, Swansea.
Francis Charles Benjamin Wood, Deurne, nr. Antwerp, Belgium.

A certificate was authorised by the Council under Bye-Law I (3) in favour of:

Joseph Valentine Francies, Engineering College, Sibpur, Calcutta.

The Council has ordered the following letter and report to be printed in the Journal and Proceedings of the Society:

GOVERNMENT LABORATORY,
CLEMENT'S INN PASSAGE,
STRAND. LONDON, W.C.
13th November, 1907.

GENTLEMEN,

I have the honour to forward you, for presentation to the Council of the Chemical Society, the Report of the International Committee on Atomic Weights, 1908, to which I have appended, as desired by them, the names of Professors Ostwald and Urbain.

It will be seen that since our last Report a number of important re-determinations of atomic weights have been published, and the existing table in consequence reveals a number of small inconsistencies due to the original data from which the values are derived. We think it is inopportune at present to attempt to recalculate these values as the work known to be in progress on certain fundamental constants, to which reference was made in our last Report, has not yet been published. We have good reason to believe, however, that it will soon make its appearance, and we hope to be able to present an amended table with our Report for next year.

I am, Gentlemen,
Your obedient Servant,
T. E. THORPE.

The Hon. Secretaries,
The Chemical Society,
Burlington House,
London, W.

Report of the International Committee on Atomic Weights, 1908.

Since the preparation of our report for 1907, several important determinations of atomic weights have been published. They are, briefly, as follows:

Nitrogen.—Richards and Forbes (*J. Amer. Chem. Soc.*, 1907, **29**, 808; *Zeitsch. anorg. Chem.*, 1907, **55**, 34) have re-determined the ratio between Ag and NO_3, as shown in the composition of silver nitrate. The ratio found, with all corrections applied, is $Ag : NO_3 = 100 : 57{\cdot}479$. Hence, if $Ag = 107{\cdot}930$, $N = 14{\cdot}037$, and if $N = 14{\cdot}008$, $Ag = 107{\cdot}880$. In short, the higher atomic weight hitherto assigned to silver is inconsistent with the lower value for nitrogen as found in several recent investigations.

Sulphur.—Richards and Jones (*J. Amer. Chem. Soc.*, 1907, **29**, 826; *Zeitsch. anorg. Chem.*, 1907, **55**, 72) have measured the ratio between Ag_2SO_4 and AgCl. From the data obtained, if Ag = 107·930, S = 32·113; a value much higher than that commonly accepted. If Ag = 107·880, then S = 32·069, which is near the figure given in our former tables. Additional evidence relative to this constant is much to be desired, for it influences the determination of many other atomic weights, especially those of the rare-earth metals.

Potassium.—From the ratios Ag : KCl and AgCl : KCl, Richards and Staehler (*J. Amer. Chem. Soc.*, 1907, **29**, 623; *Ber.*, 1906, **39**, 3611) find K = 39·114, when Ag = 107·930 and Cl = 35·473. From the corresponding bromide ratios, with Br = 79·953, Richards and Mueller (*J. Amer. Chem. Soc.*, 1907, **29**, 639; *Zeitsch. anorg. Chem.*, 1907, **53**, 423) find K = 39·1143 and 39·1135. The final result of both researches is K = 39·114, a distinct lowering of the constant in question.

Manganese.—Atomic weight re-determined by Baxter and Hines (*J. Amer. Chem. Soc.*, 1906, **28**, 1560; *Zeitsch. anorg. Chem.*, 1906, **51**, 202) from analyses of the chloride and bromide. The mean of their very concordant determinations is Mn = 54·957, when Ag = 107·930.

Cobalt.—From new analyses of the chloride, Baxter and Coffin (*J. Amer. Chem. Soc.*, 1906, **28**, 1580; *Zeitsch. anorg. Chem.*, 1906, **51**, 171) find Co = 58·997, or 59 in round numbers. This confirms the earlier determinations by Richards and Baxter.

Indium.—Mathers (*J. Amer. Chem. Soc.*, 1907, **29**, 485; *Ber.*, 1907, **40**, 1220), from analyses of indium chloride, found In = 114·88. From the bromide, In = 114·86. The author recommends the adoption of the rounded-off value, 114·9, when Ag = 107·93, Cl = 35·473, and Br = 79·953.

Tellurium.—Norris (*J. Amer. Chem. Soc.*, 1906, **28**, 1675), by twelve concordant reductions of the basic nitrate, $2TeO_2{\cdot}HNO_3$ to TeO_2, found the atomic weight of tellurium to be 127·48, when N = 14·01. With N = 14·04, Te = 127·64, which is in better agreement with other recent determinations. The true cause of the difference is not clear.

Neodymium.—Holmberg (*Zeitsch. anorg. Chem.*, 1907, **53**, 83) has re-determined the atomic weight of this element by synthesis of the sulphate from the oxide. In mean, when S = 32·06, Nd = 144·08. This is higher by 0·48 than the value given in our table.

Dysprosium.—In two series of determinations, based upon the ignition to oxide of the octohydrated sulphate, Urbain and Demenitroux (*Compt. rend.*, 1906, **143**, 598) find for the atomic weight of dysprosium values ranging between 162·29 and 162·75. In mean, Dy = 162·53.

Radium.—In a new series of three determinations, made on about 4 decigrams of the carefully-purified chloride, Madame Curie (*Compt. rend.*, 1907, **145**, 422) has found Ra = 226·18, when Ag = 107·8 and Cl = 35·4. With Ag = 107·93 and Cl = 35·45, Ra = 226·45. This is more than a unit above her previous measurements.

From the data here given, and from those cited in previous reports, it is evident that the entire table of atomic weights is in need of revision. The values assigned to K and Na are too high; those given to Cl and S are too low, and these constants affect the determinations of many others. They depend, however, upon the atomic weight of silver, which is probably, but not certainly, as low as 107·88. It is well known that work upon these fundamental constants is now nearing completion in several laboratories, notably under T. W. Richards, W. A. Noyes, and probably other investigators also. Within a few months, it should be possible to enter upon a satisfactory revision of the table, a task which would be unsatisfactory if undertaken now. It is true, as Brauner has suggested, that the present table contains inconsistencies, but they are small in amount, and are due to inconsistencies in the original data from which the values are derived. In our next report, we hope to recompute the entire table; but meanwhile, awaiting the completion of the researches which we know to be in progress, we prefer to leave the table practically unchanged. A conservative policy seems to be safer than one of haste, and the delay of another year will do no harm. One exception to the rule may, however, be made. Dysprosium, with the atomic weight 162·5, may now be properly added to the list of the chemical elements, and we recommend its insertion in the table.

It is with the deepest regret that we record the loss, by death, in February last, of our distinguished colleague, Prof. Moissan. The Chemical Society of Paris has designated Monsieur G. Urbain as his successor upon this Committee.

(Signed) F. W. Clarke,
W. Ostwald,
T. E. Thorpe,
G. Urbain.

1908.

International Atomic Weights.

		O=16.			O=16.
Aluminium	Al	27·1	Molybdenum	Mo	96·0
Antimony	Sb	120·2	Neodymium	Nd	143·6
Argon	A	39·9	Neon	Ne	20
Arsenic	As	75·0	Nickel	Ni	58·7
Barium	Ba	137·4	Nitrogen	N	14·01
Bismuth	Bi	208·0	Osmium	Os	191
Boron	B	11·0	Oxygen	O	16·00
Bromine	Br	79·96	Palladium	Pd	106·5
Cadmium	Cd	112·4	Phosphorus	P	31·0
Cæsium	Cs	132·9	Platinum	Pt	194·8
Calcium	Ca	40·1	Potassium	K	39·15
Carbon	C	12·00	Praseodymium	Pr	140·5
Cerium	Ce	140·25	Radium	Rd	225
Chlorine	Cl	35·45	Rhodium	Rh	103·0
Chromium	Cr	52·1	Rubidium	Rb	85·5
Cobalt	Co	59·0	Ruthenium	Ru	101·7
Columbium	Cb	94	Samarium	Sa	150·3
Copper	Cu	63·6	Scandium	Sc	44·1
Dysprosium	Dy	162·5	Selenium	Se	79·2
Erbium	Er	166	Silicon	Si	28·4
Europium	Eu	152	Silver	Ag	107·93
Fluorine	F	19·0	Sodium	Na	23·05
Gadolinium	Gd	156	Strontium	Sr	87·6
Gallium	Ga	70	Sulphur	S	32·06
Germanium	Ge	72·5	Tantalum	Ta	181
Glucinum	Gl	9·1	Tellurium	Te	127·6
Gold	Au	197·2	Terbium	Tb	159·2
Helium	He	4·0	Thallium	Tl	204·1
Hydrogen	H	1·008	Thorium	Th	232·5
Indium	In	115	Thulium	Tm	171
Iodine	I	126·97	Tin	Sn	119·0
Iridium	Ir	193·0	Titanium	Ti	48·1
Iron	Fe	55·9	Tungsten	W	184
Krypton	Kr	81·8	Uranium	U	238·5
Lanthanum	La	138·9	Vanadium	V	51·2
Lead	Pb	206·9	Xenon	Xe	128
Lithium	Li	7·03	Ytterbium	Yb	173·0
Magnesium	Mg	24·36	Yttrium	Yt	89·0
Manganese	Mn	55·0	Zinc	Zn	65·4
Mercury	Hg	200·0	Zirconium	Zr	90·6

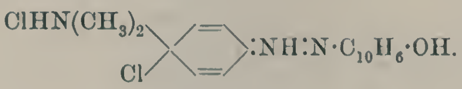
Of the following papers, those marked * were read :—

*1. “Colour and constitution of azo-compounds. Part II. The salts of *p*-hydroxyazo-compounds with mineral acids.” By John Jacob Fox and John Theodore Hewitt.

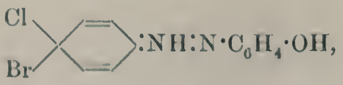
In several communications of one of the present authors, the view has been advanced that, whilst *p*-hydroxyazobenzene has a constitution which is correctly expressed by its name, the salts which it forms with mineral acids are derived from the tautomeric quinonehydrazone. W. B. Tuck (*Trans.*, 1907, **91**, 449), from a consideration of the absorption spectra of benzeneazophenol and its ethyl ether in alcoholic and concentrated hydrochloric acid solutions, concludes that the hydrochlorides of both compounds “have similar structures, and consequently the hydrochlorides of the free hydroxyl substances have an azo-structure.”

From an examination of benzeneazo-α-naphthol and its ethyl ether, the present authors agree with Tuck's statement as to similarity of structure, but deny that this structure is of azo-type, as the reactions of hydroxyazo-compounds in concentrated acid solution negative this view.

F. Baker's attempt (*Trans.*, 1907, **91**, 1490) to formulate these compounds as carbonium salts is unsatisfactory ; it requires quinquevalent nitrogen in a hitherto unobserved form, whilst the dihydrochloride of dimethylaminobenzene-azo-α-naphthol (prepared by the authors) would have to be written :



The most conclusive evidence is given by the fact that the hydrochloride of *p*-bromobenzeneazophenol and the hydrobromide of *p*-chlorobenzeneazophenol, which, according to Baker, should both have the constitution :



are actually different substances, yielding the components from which they are respectively derived when decomposed by alkali.

The present authors suggest, instead of the formulæ hitherto proposed, the constitution of oxonium salts for these compounds, for example :

$$C_6H_5\cdot NH\cdot N{:}C_6H_4{:}O(H\ \text{or}\ C_2H_5)Cl.$$

The formulation of the salts of the ethers and parent substances is thus the same, whilst the reactions in concentrated sulphuric acid solution are easily explained.

DISCUSSION.

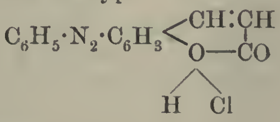
Mr. TUCK said that the absorption spectra of the hydrochlorides of the free *p*-hydroxyazo-compounds and their ethers were the same, and this fact showed that their constitutions therefore were identical. If this was so, then Dr. Hewitt's conclusion (*Ber.*, 1897, **30**, 1625) that hydrochloric acid converted the *p*-hydroxyazo-compounds into quinonehydrazones must be incorrect. This was now accepted by Dr. Hewitt.

As the absorption spectra of these hydrochlorides agreed with that of azobenzene hydrochloride, one must conclude that the acid was combined in precisely the same manner in each case, that is, the hydrochlorides were true azo-derivatives.

The objection to Dr. Hewitt's formula for the hydrochlorides lay in the fact that it was impossible to assign the same structure to azobenzene hydrochloride as he did to hydroxyazo-hydrochlorides.

Mr. BALY pointed out that Dr. Hewitt's explanation seemed to fail in two respects. In the first place, it could not account for the formation of the deeply-coloured hydrochloride of azobenzene where, of course, the oxonium structure was excluded. Moreover, the change of colour on adding hydrochloric acid to a neutral solution of azobenzene was precisely of the same character as Dr. Hewitt had shown in the case of the hydroxyazo-compounds. In the second place, the addition of the acid molecule to the oxygen atom with the formation of the oxonium salt would undoubtedly decrease the colour of the compound in the sense that the absorption band would shift towards the *blue*. In the hydrochlorides of the hydroxyazo-compounds, the absorption band had shifted towards the *red*, causing the salt to be bluer than the parent substance. This decrease in colour would be caused by the decrease in the residual affinity of the system, due to the oxygen becoming quadrivalent.

Mr. H. V. MITCHELL drew attention to the fact that he had been unable to prepare a hydrochloride of benzeneazocoumarin (*Trans.*, 1905, **87**, 1231), whereas if the view put forward by the authors were correct, a hydrochloride of the type:



$$C_6H_5\cdot N_2\cdot C_6H_3<\begin{array}{l}CH{:}CH\\ O{-}CO\\ \;\diagup\;\diagdown\\ H\;\;\;Cl\end{array}$$

might have been expected.

Dr. Hewitt, in reply, pointed out that Mr. Tuck stated definitely in his paper "the hydrochlorides of the free hydroxyl substances have an azo-structure," whilst Mr. Baly's arguments derived from the properties of benzeneazo-*p*-cresol and its derivatives depended for their validity on this substance being a quinonehydrazone. Since this point was still disputed and the bulk of the evidence seemed to be in favour of a hydroxylic structure for the free *o*-azo-compounds, the arguments lost in weight.

No surprise need be occasioned by Mr. Mitchell's inability to obtain a hydrochloride from benzeneazocoumarin, for the lactonic oxygen atom would scarcely have pronounced basic properties, whilst Professor Armstrong's arguments against the formula depended on supposed basicity of the benzene nucleus and non-existence of oxonium salts. Basicity of the benzene nucleus scarcely accorded with the feeble acidity of phenol and the diminishing basicity observed in amines by introduction of benzene nuclei, whilst the possibility of oxonium salt formation was recognised by all who had made a comparative study of the xanthhydrol and acridinium groups.

*2. "A new method of determining vapour densities. Part I." By Philip Blackman.

*3. "Studies in the camphane series. Part XXV. Action of diazomethane on the two modifications of *iso*nitrosocamphor." By Martin Onslow Forster and Henry Holmes.

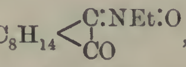
When diazomethane acts on the stable *iso*nitrosocamphor (m. p. 152°) dissolved in ether, the *N*-methyl ether is produced, whilst the unstable modification (m. p. 114°), treated with a deficit from one molecular proportion of the agent, merely undergoes isomeric change to the less fusible variety; in view of this observation, some caution will be necessary in drawing conclusions regarding the structure of a compound based on its behaviour towards diazomethane. The benzaldoximes do not behave in the same way, benz*anti*-aldoxime (m. p. 35°) yielding the *O*-methyl ether, whilst the *syn*-aldoxime (m. p. 128°) remains unchanged.

By the action of *p*-nitrobenzyl chloride on an alcoholic solution of *iso*nitrosocamphor in presence of sodium ethoxide, three products arise. The *compound*, $C_{17}H_{20}O_4N_2$, having the composition of a nitrobenzyl ether of *iso*nitrosocamphor, crystallising in pale brown prisms, melting at 175°, and having $[\alpha]_D$ 123·0°; the *compound*, $C_{17}H_{18}O_3N_2$, forming lustrous, transparent, yellow plates, melting at 214°, with

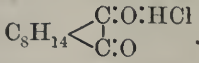
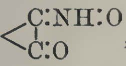
$[\alpha]_D$ $-65{\cdot}3°$, and an *oil*, which is characterised by developing an intense blue coloration when caustic alkali is added to a solution in methyl, ethyl, or *iso*butyl alcohol. If silver oxide is substituted for sodium ethoxide as a condensing agent, and *p*-nitrobenzyl chloride is replaced by the bromide, an isomeric *compound*, $C_{17}H_{20}O_4N_2$, is produced, crystallising in colourless prisms, melting at 114°, and having $[\alpha]_D$ $138{\cdot}0°$.

On mixing an ethereal solution of iminocamphor with formaldehyde, no change occurs until a trace of acid is added, when the product, dissolved in alcohol, develops an intense, magenta-red coloration with caustic alkali; ether precipitates from this solution an unstable solid, having the appearance of indigo, and yielding camphorquinone, formaldehyde, and ammonia with dilute sulphuric acid.

Camphorquinone is rapidly oxidised by an aqueous solution of hydrogen peroxide to camphoric anhydride.

The N-*ethyl* ether of *iso*nitrosocamphor,  $C_8H_{14}<\begin{array}{l}C:NEt:O\\ |\\ CO\end{array}$, produced in association with the *O*-ethyl ether when ethyl iodide acts on *iso*nitrosocamphor in presence of sodium ethoxide, melts at 57°, and has $[\alpha]_D$ $248{\cdot}1°$; it is readily hydrolysed by acids, yielding camphorquinone and ethylhydroxylamine.

DISCUSSION.

Mr. **BALY** said that the formulæ for the two forms of *iso*nitrosocamphor which Dr. Forster referred to as being given by Baly, Marsden, and Stewart had resulted from the adverse criticism their paper received when it was read. When their paper was first written, they had inclined to the nitroso-formula, and it was therefore extremely interesting to find that Dr. Forster's experiments seemed to support this view. As regards the new formula which Dr. Forster had given to the *N*-ethers of *iso*nitrosocamphor, he (Mr. Baly) spoke strongly in favour of it from the point of view of the absorption spectra of these substances. They exhibited a very marked absorption band, exactly the same as that which might be described as the middle band of *p*-benzoquinone. The latter substance in aqueous solution exhibited three absorption bands, the middle one of which was absent from the spectrum of an alcoholic solution. It had occurred to him that the middle band might be explained by the formation of a hydrate of quinone, and so the absorption spectrum was examined of an alcoholic solution of *p*-benzoquinone to which a little alcoholic solution of hydrogen chloride had been added. The absorption spectrum then showed only the middle band, and was, indeed, the same as that of the *N*-ethyl ethers of *iso*nitrosocamphor. Seeing that exactly the same was observed with camphorquinone, it did not seem unreasonable that the hydrogen chloride molecule combined by virtue of the quadrivalency of one of the oxygen atoms, and that in the case of camphorquinone a compound was formed of the type:  $C_8H_{14}<\begin{matrix}C{:}O{:}HCl\\ |\\ C{:}O\end{matrix}$. The analogy between this and Dr. Forster's new formula was sufficient to account for the similarity in the spectra of camphorquinone dissolved in alcohol containing some hydrogen chloride and the *N*-alkyl ethers of *iso*nitrosocamphor. There was no doubt that the absorption spectra offered striking evidence against either of the varieties of *iso*nitrosocamphor having the formula  $C_8H_{14}<\begin{matrix}C{:}NH{:}O\\ |\\ C{:}O\end{matrix}$, for there was no resemblance between the spectra of the *iso*nitroso-compounds and the *N*-alkyl ethers.

Dr. Hewitt asked Mr. Baly if he had convinced himself that the colourless additive product of benzoquinone and hydrochloric acid was not really chloroquinol.

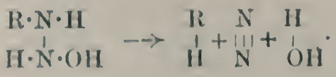
4. "The oxidation of aromatic hydrazines by metallic oxides, permanganates, and chromates." By Frederick Daniel Chattaway.

Primary aromatic hydrazines are readily attacked by most substances capable of giving up oxygen at all easily. The products are in the main the same as those which are formed by free oxygen.

The chief action, which results in the replacement of the hydrazino-group by hydrogen and the liberation of nitrogen, is generally accompanied by secondary ones which take place to a relatively very small extent. By these secondary actions, hydrocarbons of the diphenyl group or azo-derivatives are formed. Diazo-compounds are only obtained in presence of acids; in presence of alkalis, they are not formed.

Potassium chromate oxidises primary aromatic hydrazines very easily, and gives a theoretical yield of nitrogen and hydrocarbon. This reaction affords the most convenient method yet described for replacing an aromatic amino-group by hydrogen, the diazonium group yielded by it being first reduced to the hydrazino-group and this then replaced by hydrogen through oxidation with potassium chromate.

All the evidence obtained shows that the explanation of the behaviour of primary aromatic hydrazines on oxidation recently put forward by the author is correct (*Trans.*, 1907, **91**, 1324), namely, that an unstable hydroxyhydrazine is first produced, which, in presence of caustic alkali, immediately breaks down into hydrocarbon, nitrogen, and water:



$$\begin{matrix}R\cdot N\cdot H\\ |\\ H\cdot N\cdot OH\end{matrix} \longrightarrow \begin{matrix}R\\ |\\ H\end{matrix}+\begin{matrix}N\\ |||\\ N\end{matrix}+\begin{matrix}H\\ |\\ OH\end{matrix}.$$

Copper oxide easily gives up its oxygen to phenylhydrazine, and if the reduction is conducted under suitable conditions the metal can be deposited on glass in the form of a fine mirror. The film of metal thus laid down is as brilliant as a similar deposit of silver, and shows the beautiful red colour of polished copper.

5. "Studies in fermentation. Part II. The mechanism of alcoholic fermentation." By Arthur Slator.

The velocity of the conversion of dextrose, lævulose, galactose, and mannose into alcohol and carbon dioxide by the action of living yeast has been measured in the manner already described (*Trans.*, 1906, **89**, 128). The main results are as follows:

1. The rate of fermentation of dextrose, lævulose, galactose, and mannose is approximately independent of the concentration of the sugar between the concentrations 1 gram to 10 grams per 100 c.c.
2. The fermentation of dextrose and lævulose under all conditions proceeds with approximately equal velocities.
3. The temperature-coefficient is almost the same in the case of the fermentation of dextrose, lævulose, and mannose, but is somewhat less in the case of the fermentation of galactose.
4. Many yeasts (very probably all yeasts) are unable to ferment galactose unless the yeast has been grown in the presence of this sugar.
5. The ratio of the rate of fermentation of dextrose to mannose varies greatly, depending on the treatment the yeast has undergone.
6. When two sugars are fermented simultaneously in the same solution, interference takes place between the reactions.
7. The velocity of fermentation by living yeast can be easily lessened by the addition of certain inhibiting agents, but cannot be appreciably raised.
8. In all probability the fermentation of sugars by preparation from yeast proceeds on the same lines as that by living yeast, but the reaction is much complicated by secondary changes.

The supposition that the reaction which has the main control of the velocity of fermentation is the decomposition of a stable compound between the enzyme and the sugar can be made to explain these results. Possibly three enzymes are present in yeast which will ferment the four sugars: glucozymase which ferments dextrose and lævulose, galactozymase which ferments galactose, and mannozymase which ferments mannose.

6. "Organic derivatives of silicon. Part IV. The sulphonation of benzylethylpropylsilicyl oxide and of benzylethyldipropylsilicane." By Herbert Marsden and Frederic Stanley Kipping.

Although the optically-active silicon compounds described recently (Kipping, *Trans.*, 1907, **91**, 212) were actually prepared from the product of the sulphonation of benzylethylpropylsilicol, their investigation indicated that they were sulphonic derivatives of benzylethylpropylsilicyl oxide. As this view of their constitution seemed to need some confirmation, the authors have prepared benzylethylpropylsilicyl oxide itself and sulphonated it with sulphuric and with chlorosulphonic acid; in both cases there was formed an acid having the composition of a derivative of the oxide and identical with the compound which has been resolved; any uncertainty regarding the composition of the optically-active compounds is thus removed.

The sulphonation of phenylbenzylethylpropylsilicane with chlorosulphonic acid gave results similar to those obtained with sulphuric acid, that is to say, the phenyl group was eliminated and the product was a sulphonic derivative of benzylethylpropylsilicyl oxide identical with that previously described.

Benzylethyldipropylsilicane, $BzEtPr_2Si$, has been prepared and converted into *benzylethyldipropylsilicanesulphonic acid*,

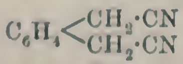
$$EtPr_2Si\cdot CH_2\cdot C_6H_4\cdot SO_3H,$$

with the aid of chlorosulphonic acid; the l-*menthylamine*, *cinchonidine*, and *quinine* salts of this acid resemble very closely the corresponding salts of *dl*-benzylmethylethylpropylsilicanesulphonic acid (*loc. cit.*, p. 717), a fact which indicates that the latter are mere mixtures of their optically-isomeric components.

Diphenylethylsilicyl chloride, $Ph_2EtSiCl$, a colourless liquid boiling at 206—208° (50 mm.), *diphenylethylsilicyl oxide*, $(Ph_2EtSi)_2O$ (m. p. 65·5°), *triphenylethylsilicane*, Ph_3EtSi (m. p. 76°), and *triphenylmethylsilicane*, Ph_3MeSi (m. p. 67—67·5°), were also described.

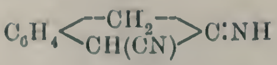
7. "The formation and reactions of imino-compounds. Part VI. The formation of derivatives of hydrindene from *o*-phenylenediacetonitrile." By Charles Watson Moore and Jocelyn Field Thorpe.

When *o*-phenylenediacetonitrile (I) is warmed in alcoholic solution containing a trace of sodium ethoxide, it is completely converted into *a-cyano-β-iminohydrindene* (II), which can be hydrolysed to *a-cyano-β-hydrindone* (III):



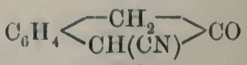
$C_6H_4<\begin{matrix}CH_2\cdot CN\\ CH_2\cdot CN\end{matrix}$

(I.)



$C_6H_4<\begin{matrix}-CH_2-\\ CH(CN)\end{matrix}>C{:}NH$

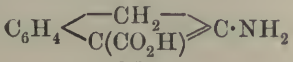
(II.)



$C_6H_4<\begin{matrix}-CH_2-\\ CH(CN)\end{matrix}>CO$

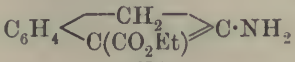
(III.)

α-Cyano-β-iminohydrindene (II) is a neutral imino-compound, which is hydrolysed by dilute acids and does not evolve nitrogen with nitrous acid. If, however, the nitrile group is replaced by carboxyl, carboethoxyl, or the carboxylamino group, the compounds formed are true bases. Thus 2-*aminoindene-3-carboxylic acid* (IV), *ethyl 2-aminoindene-3-carboxylate* (V), and 2-*aminoindenecarboxyl amide* (VI):



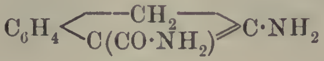
$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\C(CO_2H)\end{array}\right\rangle C\cdot NH_2$$

(IV.)



$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\C(CO_2Et)\end{array}\right\rangle C\cdot NH_2$$

(V.)

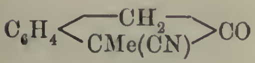


$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\C(CO\cdot NH_2)\end{array}\right\rangle C\cdot NH_2$$

(VI.)

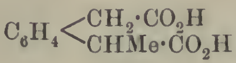
are all bases, which are not hydrolysed by dilute acids and evolve free nitrogen when treated with nitrous acid. There is no evidence that these compounds are capable of reacting in the imino-form.

α-Cyano-β-hydrindone (III) gives a well-defined *phenylhydrazone*, and on methylation yields *α-cyano-α-methyl-β-hydrindone* (VII), which gives *phenyleneaceticpropionic acid* (VIII) on hydrolysis. When, however, the ketone is treated with sodium ethoxide and ethyl iodide, the *O*-ethyl derivative, 3-*cyano-2-ethoxyindene* (IX), is alone produced:



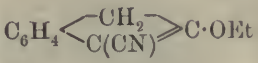
$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\CMe(CN)\end{array}\right\rangle CO$$

(VII.)



$$C_6H_4\left\langle\begin{array}{c}CH_2\cdot CO_2H\\CHMe\cdot CO_2H\end{array}\right.$$

(VIII.)



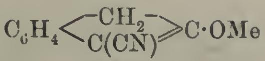
$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\C(CN)\end{array}\right\rangle C\cdot OEt$$

(IX.)

α-Cyano-β-hydrindone (III) reacts also as a phenol, since it can be readily alkylated by alkyl sulphates, yielding, with methyl sulphate, 3-*cyano-2-methoxyindene* (X) and with ethyl alcohol and sulphuric acid, 3-cyano-2-ethoxyindene (IX) identical with the compound prepared by the alkylation of the ketone with sodium ethoxide and ethyl iodide. The constitution of these salts is shown by their hydrolysis with dilute acids to α-cyano-β-ketohydrindene.

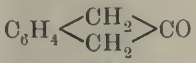
It is therefore probable that groups greater than Me and CN cannot attach themselves to the α-carbon atom of β-hydrindone or β-iminohydrindene, and it is suggested that the term "stearic inhibition" should be applied to this phenomenon rather than "stearic hindrance."

β-Hydrindone (XI) can be prepared by distilling with steam a solution of 2-aminoindene-3-carboxylic acid (IV) in dilute sulphuric acid:



$$C_6H_4\left\langle\begin{array}{c}-CH_2-\\C(CN)\end{array}\right\rangle C\cdot OMe$$

(X.)



$$C_6H_4\left\langle\begin{array}{c}CH_2\\CH_2\end{array}\right\rangle CO$$

(XI.)

This substance is quite stable when pure, and does not show any tendency to pass into a brown resin as stated in the literature.

8. "Valency." By John Albert Newton Friend.

The author suggested a new theory of valency by means of which many reactions receive explanations not forthcoming from the usually accepted theory. The theory was also considered in its relation to that of Werner.

9. "The esterification constants of the normal fatty acids." By John Joseph Sudborough and James Mylam Gittins.

The esterification constants of some sixteen of the more common normal fatty acids, from formic to stearic acid, have been determined.

The value $E^{15^{\circ}}_{MeOH}$ for formic is 1124; acetic, 104; propionic, 92; and from butyric to stearic acid the value remains nearly constant, varying from about 50 to 54.

10. "The anomalous behaviour of the hydrogen electrode in solutions of lead salts and the existence of univalent lead ions in aqueous solutions." By Henry George Denham and Arthur John Allmand.

An attempt has been made to measure the hydrolysis of lead salts by the hydrogen electrode, but results were obtained which were far higher than those recorded by Ley (*Zeitsch. physikal. Chem.*, 1899, **30**, 193), and it was also noticed that many hours were required for the electrode to give a constant potential. This has been proved to be due to the reaction:

$$Pb^{\cdot\cdot} + H \longrightarrow Pb^{\cdot} + H^{\cdot}$$

occurring at the platinum electrode.

The existence of plumbous acetate in aqueous solutions has been conclusively proved by carrying out an experiment of the type described by Richards, Collins, and Heimrod (*Zeitsch. physikal. Chem.*, 1900, **32**, 321) for copper and by Bose (*Zeitsch. Elektrochem.*, 1907, **13**, 477) for silver. In hot solution, lead reduces lead acetate to plumbous acetate, but the reaction is reversed in the cold, crystalline lead being deposited in the cold parts of the apparatus. The ionic reaction is evidently:

$$Pb^{\cdot\cdot} + Pb \longrightarrow 2Pb^{\cdot}.$$

It has also been proved that a rod of lead, immersed in a molar-normal solution of lead acetate, the upper part of which is kept hot by a steam-jacket, forms a thermo-electric cell. A weak thermo-current flows from the hot solution to the colder below, and, after a week, definite traces of spongy lead may be recognised at the junction of the hot and cold solutions.

11. "Amphoteric metallic hydroxides. Part I."

By John Kerfoot Wood.

The author has investigated the amphoteric character of the hydroxides of arsenic and aluminium. Arsenic hydroxide is a very feeble base, the basic constant being of the dimensions of 1×10^{-14}. The acidic constant, as found by the saponification method, has a value of $6{\cdot}3 \times 10^{-10}$, and an $N/10$ solution of sodium metarsenite is hydrolysed to the extent of 1·4 per cent. at 25°. The dissociation constant of arsenious acid, as found by the conductivity method, has a value of $26{\cdot}5 \times 10^{-10}$.

Aluminium hydroxide is a weak base. The chloride is hydrolysed to the extent of about 4 per cent. at 25°, and is probably transformed into a basic chloride having the formula $Al(OH)Cl_2$. Sodium metaluminate in $N/10$ solution is hydrolysed to the extent of about 35 per cent. at 25°, the acidic constant of aluminium hydroxide being $6{\cdot}3 \times 10^{-13}$.

12. "The use of pyridine bases as halogen carriers."

By William Ernest Cross and Julius Berend Cohen.

The authors have shown that the process of halogen substitution in the case of aceto-*p*-toluidide and other amides is preceded by the formation of additive compounds (*Proc.*, 1907, **23**, 326), but attempts to effect substitution in a similar manner by means of the additive compounds of the pyridine bases with bromine failed.

The result, however, suggested the possibility of employing these bases as halogen carriers, an anticipation which has been confirmed by the following experiments.

Chlorobenzene.—Chlorine was passed into 50 grams of benzene containing a few drops of pyridine, and the mixture was warmed to 50°. The action proceeded rapidly with evolution of hydrogen chloride. The product was shaken with alkali, dehydrated, and distilled. Some unchanged benzene and a little dichlorobenzene were separated. The yield of pure chlorobenzene was 30 grams.

Chlorotoluenes.—The chlorination proceeds at the ordinary temperature. From 43 grams of toluene, 25 grams of mixed chlorotoluenes were obtained, b. p. 150—165°, together with a few grams of higher boiling products.

Bromobenzene.—A few drops of pyridine were added to a mixture of 50 grams of benzene and 120 grams of bromine, which were warmed to 25° in the water-bath. The action proceeds vigorously with the evolution of hydrogen bromide. The temperature was finally raised to 65—70°. The crude product, which boiled at 148—158°, amounted to 60 grams. The same result was produced with quinoline and *iso*-quinoline.

Dibromobenzene.—The *p*-dibromo-compound was obtained in a similar manner. From 33 grams of bromobenzene, 20 grams of the para-compound, m. p. 87°, were obtained, the remainder being unchanged bromobenzene. No ortho-compound was detected.

Bromotoluene.—Fifty grams of toluene yielded 87 grams of bromotoluene, b. p. 178—182°.

4-*Chloro*-1-*bromotoluene.*—Fifty-five grams of *p*-chlorotoluene gave 56 grams of chlorobromotoluene, b. p. 220—235°, and a small quantity of lower and higher boiling products.

α-Bromonaphthalene.—The α-compound was prepared by dissolving 25 grams of naphthalene in 100 c.c. of chloroform and adding 36 grams of bromine and a few drops of pyridine. The mixture was left in the cold for twenty-four hours. After purification, 35 grams of α-bromonaphthalene were obtained, b. p. 276—278°.

13. "Decomposition of hyponitrous acid." By Edward Divers.

By suddenly drenching dry silver hyponitrite or mercurous hyponitrite at a temperature but little below 30° with a mineral acid, not greatly diluted in the case of hydrochloric acid or sulphuric acid, and only sufficiently so in the case of nitric acid to avoid inducing its oxidising action, Rây and Gañguli * have obtained nitric acid and nitrogen as products of decomposition, in place of much of the nitrous oxide which was to be expected. This interesting observation throws much light on the nature of the decomposition of silver and mercury hyponitrites by heat. These authors, indeed, suggest that the presence of mineral acids has a "specific directive influence" in determining the form of the decomposition, but that is a notion without evident support. That sulphuric acid should be less effective in bringing about the decomposition is sufficiently accounted for by the fact that the comparative insolubility of silver and mercurous sulphates greatly impedes the action of this acid on the hyponitrites and the rise of temperature which attends it.

Through Rây and Gañguli's observations, we are at length in possession of much knowledge of what the products are when hyponitrous acid decomposes, without explosion, by the heat generated in liberating it from its salts. Since hyponitrous acid yields only nitric acid and nitrogen (water and nitrous oxide being here negligible), whilst silver hyponitrite or mercurous hyponitrite yields, besides these, much nitric oxide and some nitrous acid or nitric peroxide, we can now see that production of the latter substances is due to the unstable oxidised silver or mercury. Writing hyponitrous acid as H_2O,N_2O, and its silver salt as Ag_2O,N_2O, we see that $5N_2O$ become $4N_2+N_2O_5$, the water remaining unchanged in the former case, whereas the silver oxide in the latter case is reduced to metal, whilst its oxygen becomes active. Hence we obtain the two equations :

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* *Trans.*, 1907, 91, 1866.

$$5H_2O_2N_2=4H_2O+4N_2+2HNO_3,$$

and

$$3Ag_2O_2N_2=4Ag+2N_2+2AgNO_3.$$

Similarly, the production of nitric oxide and peroxide is referable to the reducibility of oxidised silver or mercury, and could only come from hyponitrous acid through a highly improbable cumulative resolution of nitrous oxide.

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I. *Donations.*

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From Professor W. R. Hodgkinson.

II. *By Purchase.*

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III. *Pamphlets.*

Arnott, *M. H.* The construction of drain gauges at Pusa. (From the *Mem. Dept. Agric. India,* **1**, 1907.)

Schüller, *Bernhard.* Carl Friedrich Mohr. (Reprint from the *Festschrift des Real-Gymnasiums zur Einweihungsfeier des Neubaues,* 1907.)

Singh, *Puran.* Researches on cantharidine, its extraction and determination. pp. 16. Lahore 1907.

LOTHAR MEYER MEMORIAL.

The Council has decided to make a donation of £10 to the Lothar Meyer Memorial Fund.

Many old pupils and admirers of the author of "Die Modernen Theorien der Chemie" may be desirous of contributing to this Memorial, and the Treasurer will be glad to receive, at an early date, subscriptions from Fellows and others to the Fund.

Cheques, &c., should be made payable to Dr. Alexander Scott, crossed "Lothar Meyer Memorial Fund A/c.," and sent to the Treasurer, Chemical Society, Burlington House, W.

ERRATUM.

1907. p. 305, line 5 from top, *for* "**alkalis**" *read* "**alkali metals.**"

At the next Ordinary Meeting on **Thursday**, February **6**th, 1908, at **8.30** p.m., there will be a ballot for the election of Honorary and Foreign Members and the following papers will be communicated :

"The metallic picrates." By O. Silberrad and H. A. Phillips.

"Organic derivatives of silicon. Part V. Benzylethylsilicane, dibenzylsilicane, and other benzyl- and benzylethyl-derivatives of silicane." By R. Robinson and F. S. Kipping.

"Some physico-chemical properties of mixtures of pyridine and water." By H. Hartley, N. G. Thomas, and M. P. Appleby.

"The constitution of umbellulone. Part III." By F. Tutin.

"The residual affinity of the coumarins and thiocoumarins as shown by their additive compounds." By A. Clayton.

R. CLAY AND SONS, LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 14/2/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 336.

Thursday, February 6th, 1908, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society owing to the death of Mr. W. A. Shenstone, F.R.S. (elected in 1876), and of Mr. R. J. Friswell (elected in 1871).

Certificates were read for the first time in favour of Messrs.:

Arthur John Allmand, B.Sc., Central Laboratories, Widnes.
William Henry Benson Baker, B.A., Frognal Dene, Hampstead, N.W.
Josiah Leonard Bowen, 8, West Field, Lightcliffe, near Halifax.
Charles Gilling, 30, Carnarvon Road, Barnet.
Alwyne Harcourt Meade, Cedar House, St. Neots.
Herbert Richard Neech, 20, Colegrave Street, Lincoln.
Thomas Richards Phillips, Stanhope House, Abergavenny.
Francis Edward Richards, B.Sc., County Secondary School, Redruth.
William Wheatley, B.A., 21, Bairstow Street, Preston.

A Ballot for the election of Honorary and Foreign Members was held, and the following were subsequently declared duly elected:

Armand Emile Justin Gautier.
Albin Haller.
Johann Wilhelm Hittorf.
Joseph Achille Le Bel.
Henry Louis Le Chatelier.
Theodore William Richards.
Otto Wallach.

Of the following papers, those marked * were read :—

*14. "The metallic picrates." By Oswald Silberrad and Henry Ablett Phillips.

Older investigations on the picrates show so many discrepancies that a systematic revision of the work has been undertaken, with the result that the water of crystallisation and properties of the commoner salts have been definitely established. Several new salts were also described.

*15. "Some physico-chemical properties of mixtures of pyridine and water." By Harold Hartley, Noel Garrod Thomas, and Malcolm Percival Applebey.

With the view of examining the effect of the gradual replacement of water by pyridine on the electrical conductivity of salt solutions, and of tracing a connexion between the properties of the solvent and of the solution, the following physical constants have been determined: the density, viscosity, and surface tension of pyridine-water mixtures at 0° and 25°, the density and viscosity of one-eighth weight-normal solutions of lithium nitrate in a series of mixtures at 0° and 25°, and the molecular conductivity of these solutions at various dilutions at the same temperatures.

The density and viscosity curves all show a maximum deviation from the line joining the end values in the neighbourhood of 30 mol. per cent. pyridine, both at 0° and 25°. No evidence was found for the existence of the discontinuities described by Dunstan, Thole, and Hunt (*Trans.*, 1907, **91**, 1718), all the observations lying on smooth curves.

By the application of Stokes' equation respecting the limiting velocity of a small sphere moving in a viscous medium under the influence of a constant force, the variation in the size of the solvent atmospheres attached to the ions at infinite dilution has been calculated.

It was shown to what extent the variations of the molecular conductivity of lithium nitrate solutions with the composition of the solvent can be ascribed to changes (1) in the coefficient of ionisation, (2) in the fluidity of the solution, and (3) in the aggregation of solvent particles round the ions.

Discussion.

Mr. Dunstan pointed out that some misconception had evidently arisen in the minds of the authors as to the curves published by

Messrs. Thole, Hunt, and himself (*Trans.*, 1907, **91**, 1728). For the purpose of more clearly representing the composition of the hydrates of pyridine, the tangents to the curves at the points of flexure were produced, and this gave rise to the erroneous impression that the curves were built up in sections. He also drew attention to the fact that every such "discontinuity" in the density curve was repeated in the viscosity curve, and instanced the work of Pickering in support of the contention that such hydrates do exist in solution.

Mr. R. J. Caldwell agreed with the authors that the usefulness of most previous work on strong solutions is impaired by the fact that "volume normal" solutions have been employed instead of solutions made up by weight. He had already measured electrical conductivities of solutions made up by weight, taking account of the density, as the authors appeared to have done.

The specific rotatory power of sucrose varied from 66·5° in pure water to 83·8° in pure pyridine, but until the concentration of the pyridine reached 30 per cent. the rotatory power did not vary much from the value obtained in pure water (Wilcox, *J. Physical Chem.*, 1901, **5**, 592). At low concentrations, the pyridine, existing doubtless in a hydrated condition, was prevented from exerting any influence on the dissolved sugar. The values obtained by the authors for the conductivity of lithium nitrate appeared to be entirely analogous, leading to the same conclusion with regard to the pyridine.

Mr. Hartley said that he did not believe in the existence of any irregularities in the density or viscosity curves, as the greater the care with which the determinations were made the more nearly did the experimental values lie on smooth curves. The determination of density was so much more accurate an operation than the determination of viscosity, that he did not think the anomalies in the viscosity curves could be explained by those in the density curves. In reply to Dr. Barger, he said that the authors recognised that pyridine possessed residual valencies, although the liquid molecules were probably unassociated, otherwise it would have no dissociating influence on salts dissolved in it.

*16. "The constitution of umbellulone. Part III."

By Frank Tutin.

Semmler's recent statements (*Ber.*, 1907, **40**, 5017) respecting the constitution of umbellulone are based on experiments conducted with "β-dihydroumbellulone" and its derivatives. Since the material employed by Semmler consisted of highly impure umbellulone, there is no evidence in support of the assumption that "β-dihydroumbellulone" is a derivative of umbellulone, but, on the other hand, the experimental facts lead to the contrary conclusion.

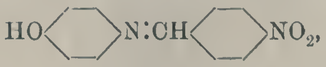
In addition to this uncertainty regarding the source of the preparation which had been called "β-dihydroumbellulone," this has now been shown to be a mixture, consisting chiefly of an unsaturated ketone, but also containing a saturated one, and it can only be from the latter that Semmler has prepared homotanacetonedicarboxylic acid.

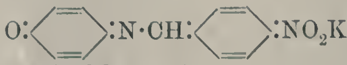
Semmler's results, therefore, are devoid of significance in so far as they pertain to the constitution of umbellulone.

*17. "Colour and constitution of azomethine compounds." Part I.

By Frank George Pope.

The nitrohydroxyazomethine compounds show an entirely different absorption spectrum from that of their alkali salts when the nitro- and hydroxyl groups are in the para-position to the azomethine group, and, from the similarity of the ·N:CH· grouping to the ·N:N· grouping in many respects, it would seem apparent that the alkali salts of these compounds could be formulated on a di-quinonoid basis, the free hydroxyl compounds being represented thus:



and the alkali salts as  (compare Hewitt and Mitchell, *Trans.*, 1907, **91**, 1251).

A similar state of things may also be observed, although to a slightly less extent as regards absorption, when the nitro- and hydroxyl groups are in the ortho- and para-positions to the azomethine grouping.

The following compounds were described: p-4-*nitrobenzylideneaminophenol*, m. p. 168·5°; o-4-*nitrobenzylideneaminophenol*, m. p. 161°; p-3-*nitrobenzylideneaminophenol*, m. p. 154°; o-3-*nitrobenzylideneaminophenol*, m. p. 135°; o-*hydroxybenzylidene*-m-*nitroaniline*, m. p. 132°.

Discussion.

Dr. Hewitt remarked that, whilst the general type of absorption was similar for corresponding azo- and azomethine compounds, replacement of a nitrogen atom by a methenyl group increased the oscillation frequency.

*18. "The preparation of *l*-benzoin."

By Alexander McKenzie and Henry Wren.

l-Benzoin, obtained from *l*-mandelamide and magnesium phenyl bromide, melts at 131—132·5°, reduces Fehling's solution, and has $[\alpha]_D^{10·5}$ $-118·6°$ for $c=0·9232$ in acetone solution.

Discussion.

Dr. McKenzie, in reply to Dr. Lowry and Dr. Lander, stated that no racemisation, either partial or complete, had so far been observed with *l*-benzoin.

19. "Organic derivatives of silicon. Part V. Benzylethylsilicone, dibenzylsilicone, and other benzyl and benzylethyl derivatives of silicane." By Robert Robison and Frederic Stanley Kipping.

Benzylethylsilicone, BzEtSiO, prepared from benzylethylsilicon dichloride (Kipping, *Trans.*, 1907, **91**, 720), has little in common with benzyl ethyl ketone; it boils at 305—315° (22 mm.), is not reduced by various reagents, and gives neither an oxime nor a hydrazone; molecular weight determinations in acetic acid solution point to the formula $(BzEtSiO)_3$.

Benzylethylsiliconesulphonic acid is easily obtained by sulphonating the silicone with sulphuric acid; the *barium* salt, $(C_9H_{11}SiSO_4)_2Ba$, is soluble in water, but does not crystallise well.

Dibenzyl ethyl silicol, $Bz_2EtSi{\cdot}OH$, was obtained as an oil; it passes spontaneously into *dibenzylethylsilicyl oxide*, $(BzEtSi)_2O$, a crystalline substance melting at 54°.

Tribenzylsilicyl chloride, Bz_3SiCl, crystallises in prisms melting at 141°, and is decomposed by water, giving tribenzylsilicol.

Dibenzylsilicon dichloride, Bz_2SiCl_2, prepared from silicon tetrachloride and magnesium benzyl chloride, crystallises in massive prisms and melts at 50—52°; when decomposed with water, it yields a *hydrol* of the molecular formula, $Bz_2Si(OH)_2$, which crystallises in long, asbestos-like needles melting at about 101° (*α-hydrol*), and also an isomeric *hydrol*, which forms large, transparent prisms melting at about 75° (*β-hydrol*); the latter was recently described by Dilthey (*Ber.*, 1905, **38**, 4132). In some cases, only one of these hydrols is formed, and in others both are obtained, the β-isomeride predominating, but the conditions which determine their formation are unknown. Both hydrols pass into *dibenzylsilicone* (an oil) when they are heated, and the β-compound is readily reproduced by treating this oil with water; the α-hydrol is not regenerated in this way. Both hydrols give termolecular *dibenzylsilicone*, $(Bz_2SiO)_3$ (m. p. 98°), when they are heated with acetic anhydride.

The experimental data do not yet afford any explanation of the existence and relationship of these isomeric hydrols.

20. "The residual affinity of the coumarins and thiocoumarins as shown by their additive compounds." By Arthur Clayton.

The coumarins and thiocoumarins combine with mercuric chloride, forming compounds of the type $R,HgCl_2$, where R is a coumarin or a thiocoumarin. This combination takes place with the following coumarins and their sulphur analogues: coumarin, 7-methylcoumarin, 4 : 7-dimethylcoumarin; 3 : 4 : 7-trimethylcoumarin, thiocoumarin, 7-*methylthiocoumarin* m. p. 125—126°, 4 : 7-*dimethylthiocoumarin* m. p. 118—119°, and 3 : 4 : 7-*trimethylthiocoumarin* m. p. 124—125°. The thiocoumarins are prepared by the action of phosphorus pentasulphide on the corresponding coumarins, and, unlike the coumarins, yield oximes and phenylhydrazones.

Other oxonium compounds of the coumarins were described.

21. "The influence of foreign substances on certain transition temperatures and the determination of molecular weights." By Harry Medforth Dawson and Colin Gyrth Jackson.

The depression of the temperatures at which changes take place in certain condensed systems on the addition of foreign substances has been examined. The changes investigated were: (1) the conversion of sodium thiosulphate primary pentahydrate into the corresponding dihydrate at 48·1°; (2) the transformation of sodium bromide dihydrate into the anhydrous salt at 50·67°, and (3) the formation of tachhydrite $(CaCl_2,2MgCl_2,12H_2O)$ from calcium and magnesium chloride hexahydrates at 22·40°.

Constants representing the depression of the transition temperature when 1 gram-molecule of the foreign substance is contained in 100 grams of the saturated transition solution have been calculated. From a knowledge of these constants, the corresponding invariant points may be utilised for the purpose of obtaining the molecular weights of dissolved substances.

22. "The bromination of *p*-hydroxydiphenylamine."

By Alice Emily Smith and Kennedy Joseph Previté Orton.

The bromination of *p*-hydroxydiphenylamine is rendered difficult by the readiness with which oxidation to a quinoneanil, $Ar\cdot N\colon C_6H_4\colon O$, is effected. All attempts to prepare mono- or di-bromo-derivatives failed, a tribromo-compound apparently being the primary product of bromination. It is a very remarkable fact that isomeric tri- and tetra-bromo-derivatives are not formed, the successive entrance of the bromine atoms following a single definite course.

The *tri-*, *tetra-*, *penta-*, *hepta-*, and *octa-bromo*-p-*hydroxydiphenylamines*, and the corresponding *benzoxy*-derivatives and *quinoneanils* (*phenyliminoquinones*) were described.

23. "The decomposition of ammonium dichromate by heat."

By William Marrs Hooton.

It is generally stated that ammonium dichromate on ignition decomposes quantitatively into nitrogen, water, and chromium sesquioxide; but Darby, in 1849, pointed out that a little ammonia was always liberated, and the author has found that the gaseous products of decomposition in air or in a vacuum always contain appreciable amounts of oxygen and oxides of nitrogen. Moreover, the solid residue is not homogeneous; it contains dark brown flakes, and evolves water when heated to bright redness.

If, instead of igniting the salt, it is decomposed slowly by heating it in air below its ignition temperature (190°) until the weight is constant, atmospheric oxygen takes part in the change. The final product is a hydrated form of chromium dioxide, having the composition $2CrO_2,H_2O$. It is a glistening, black powder, which on being strongly heated yields oxygen, water, and chromium sesquioxide without incandescence. When heated with hydrochloric acid, chlorine is freely evolved. When boiled with potassium hydroxide solution, it yields potassium chromate and chromium hydroxide.

If ammonium dichromate is heated below its ignition temperature in a vacuum or in absence of oxygen, the final product is a dull greenish-black powder having the composition $H_2Cr_2O_4$. This is not a hydrated form of chromium sesquioxide, for it incandesces brightly when heated to 400°. Even after boiling with water, filtering, and drying, it still incandesces when heated to 400°. During incandescence, water is formed, but no gas is liberated, and the sesquioxide formed is not bulky. This compound is not acted on by boiling potassium hydroxide solution, and only slowly by hot hydrochloric acid, no chlorine being evolved.

24. "The effect of constitution on the rotatory power of optically active nitrogen compounds. Part II." By Humphrey Owen Jones and John Robertshaw Hill.

The authors have resolved a set of five optically active nitrogen compounds, and have determined the rotatory powers of the basic ions (compare *Trans.*, 1906, **89**, 282).

The compounds contain the *p*-bromophenyl, methyl, and allyl groups with one of the homologous groups, ethyl, *n*- or *iso*-propyl, *iso*butyl, or *iso*amyl, and differ from those, forming one of the sets already described only in the replacement of one of the hydrogen atoms of the phenyl group by bromine.

The *n*-propyl, *iso*butyl, and *iso*amyl compounds were resolved by means of *d*-bromocamphorsulphonic acid, the *iso*propyl compound by means of *d*-camphorsulphonic acid, and the ethyl compound by means of *d*-tartaric acid. The following table summarises the results obtained:

		Molecular rotatory power	
	Melting point of iodide.	of ion at 15°.	of iodide in alcohol.
Ethyl …………	142—143°	− 31°(?)	− 20°
n-Propyl ………	142—143	+141	+144
*iso*Propyl .. ……	153	+161	+165
*iso*Butyl ………	133—134	+ 96	+117
*iso*Amyl ………	135—136	+ 94	+111

The rotatory power of the iodide in chloroform was determined when possible, and was found to be greater than in alcohol; autoracemisation of the iodide occurred in chloroform in all cases.

The maximum rotatory power is found in the propyl compounds just as in the set of unbrominated compounds, also the rotatory power of this set of compounds, with the exception of the ethyl compound, is considerably greater than that of the unbrominated set.

25. "Malacone, a silicate of zirconium." By Alexander Charles Cumming.

The author finds that the formula ZrO_2,SiO_2 corresponds more closely with the observed composition of malacone than does the formula $3ZrO_2,2SiO_2$ assigned to it by Kitchin and Winterson (*Trans.*, 1906, **89**, 1568).

A detailed examination gave no reason to suspect the identity of the zirconia, or to suspect the presence of an unknown impurity. The presence of argon cannot be explained by the presence of any new radioactive element, as the radioactivity can be sufficiently accounted for by the presence of radium.

26. "The reducibility of magnesium oxide by carbon." By Roland Edgar Slade.

The isolation of magnesium by direct reduction of the oxide by carbon has been effected at temperatures above 1700°, and the chief hindrance to the preparation of the metal by this reaction has been found to be due to the back reaction which occurs at lower temperatures between magnesium and carbon monoxide.

Various methods were adopted for removing the metal from contact with the carbon monoxide. Rapid evacuation of the vessel in which the reaction occurs, absorption of the magnesium by molten copper, and reduction of magnesia in presence of aluminium, or in a swift stream of hydrogen, have all proved successful.

27. "The crystal form of halogen derivatives of open-chain hydrocarbons with reference to the Barlow-Pope theory of structure." By Frans Maurits Jaeger.

The author has determined the crystalline forms of a number of halogen derivatives of open-chain hydrocarbons, such as tetrabromo-$\beta\beta$-dimethylpropane, 1:3:5-hexatriene, di- and tetra-bromide and tetraiodoethylene, for the purpose of ascertaining whether predictions concerning their crystalline form, based on the theory of Barlow and Pope, are justified by the experimental results. In accordance with the indications of the theory, it is found that the substances named above exhibit a close morphotropic relationship. The theory also allows of the prediction that tetrabromo-$\beta\beta$-dimethylpropane should be represented by a pseudo-cubic assemblage; actually it is found that, although the compound crystallises in the monosymmetric system, it is pseudo-cubic.

28. "The determination of the rate of chemical change by measurement of the gases evolved." By Francis Edward Everard Lamplough.

Further work on the above subject has confirmed the results given in a former communication (*Proc.*, 1906, **22**, 280), with the exception of the paragraph referring to the decomposition of ammonium nitrite.

A few experiments have been performed on the action of sodium hypochlorite on carbamide. The rate of evolution of gas does not give results which can be interpreted by a simple law, owing to the complexity of the reaction; the velocity of the reaction, as measured by the rate of evolution of gas, rises to a maximum and then diminishes.

The reaction between nickel carbonyl and iodine has been found to be of a complex nature, even in cases where either reagent is in considerable excess. When the nickel carbonyl is present in great excess, a remarkable phenomenon is met with, the action proceeding in a steady manner until a point is reached at which it abruptly terminates almost without warning.

29. "The temperatures of spontaneous crystallisation of mixed solutions, and their determination by means of the index of refraction. Mixtures of solutions of sodium nitrate and lead nitrate." By Florence Isaac.

Previous experiments on simple solutions established a "supersolubility curve" which marks their temperatures of "spontaneous" crystallisation.

The supersolubility curve for a mixture of three constituents, sodium nitrate, lead nitrate, and water, has now been determined by measurement of the refractive indices.

In the first set of twenty-two experiments, the proportion of lead nitrate to water was kept constant as 3 : 10, whilst the amount of sodium nitrate varied; in the second set of seventeen experiments, the proportion of sodium nitrate to water was kept constant as 3 : 4, whilst the amount of lead nitrate varied.

In both cases, it was found that as the temperature of the liquid falls the refractive index rises to a maximum value. A few crystals usually appear in the supersaturated solution before the maximum index is reached, and at, or about, the maximum point spontaneous crystallisation sets in and gives rise to a dense shower of crystals.

In each set, these maximum points determine the "supersolubility" curve.

The two supersolubility curves may be regarded as plane sections of a supersolubility surface for all possible mixtures of the three constituents.

The curves of spontaneous crystallisation were also determined by experiments with the same solutions in sealed glass tubes. These cannot be made to crystallise until they have reached the temperature already determined from the refractive indices.

The solubility curves for these mixtures were also determined, and their relation to the supersolubility curves established.

30. "Contributions to the chemistry of the terpenes. Part III. Some oxidation products of pinene." By George Gerald Henderson and Isidore Morris Heilbron.

The acid $C_9H_{15}CO_2H$, obtained from pinene as previously described (Henderson and Gray, Trans., 1903, 83, 1299), could not be brominated directly, but was converted into its *chloride*, a viscous, colourless oil. When heated with bromine, this yields the *chloride* of a *bromo-acid*, $C_9H_{14}Br{\cdot}COCl$, an oily liquid, from which, with water, the *bromo-acid*, $C_9H_{14}Br{\cdot}CO_2H$, was obtained. This is a crystalline solid, and when boiled with aqueous sodium carbonate yields the *hydroxy-acid*, $C_9H_{14}(OH){\cdot}CO_2H$, crystallising from water in colourless prisms. Its *sodium* salt is readily, and its *silver* salt very sparingly, soluble in water.

In preparing the bromo-acid, a small quantity of a crystalline, neutral *compound*, apparently of the composition $C_{10}H_{13}OBr$, separated. Along with the hydroxy-acid there was also obtained a small amount of another *acid*, probably of the formula $C_{10}H_{14}O_2$, which is crystalline and insoluble in water. Its *silver* salt crystallises from water in colourless needles.

The ketone previously described (*loc. cit.*) has now been obtained in a pure state, and has the formula $C_9H_{14}O$. On reduction, it yields the *alcohol*, $C_9H_{15}{\cdot}OH$, a colourless, oily liquid, from which a *phenylurethane* and an *acid phthalic ester*, both crystalline solids, have been prepared.

When heated with ammonium formate, the ketone is converted into the formyl derivative of an *amine*, $C_9H_{15}{\cdot}NH_2$, which is a colourless liquid with a disagreeable odour, and is almost insoluble in water. Its *hydrochloride*, which is extremely easily soluble in water, crystallises in silky needles, and its *platinichloride* in pale yellow leaflets.

The chlorinated oxidation product which is separated during the purification of the ketone is a white, crystalline solid of formula $C_{10}H_{15}OCl$. It is slowly decomposed when heated with alcoholic sodium ethoxide, and yields a colourless, crystalline compound, which does not contain chlorine and has a penetrating odour.

31. "A β-lactonic acid from acetone and malonic acid."
By Andrew Norman Meldrum.

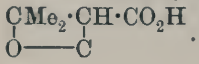
When malonic acid and acetone are mixed with acetic anhydride and a little sulphuric acid, the malonic acid dissolves, and after twenty-four hours a new, crystalline acid is obtained, which melts at 97° and decomposes at a higher temperature. The composition and the molecular weight (determined by the boiling-point method) lead to the formula $C_6H_8O_4$.

The substance is saturated; it decomposes easily, under various conditions, into acetone and malonic acid (or, in place of malonic acid, carbon dioxide and acetic acid), and when heated with aniline it gives acetone, carbon dioxide, and acetanilide.

Since the acid is monobasic and yields the salts:

$$C_6H_7O_4Ag,\ C_6H_7O_4Na,\ C_6H_7O_4K,H_2O,$$

it is evidently the *β-lactone* of *β-hydroxy*iso*propylmalonic acid*,



$$\begin{array}{l}CMe_2\cdot CH\cdot CO_2H \\ \vert \qquad\ \ \vert \\ O\text{——}C\end{array}.$$

ERRATUM.

1908, p. 3, line 14 from below, *for* "$2TeO_2\cdot HNO_3$" *read* "$2TeO_2,HNO_3$."

At the next Ordinary Meeting, on **Thursday**, February **20th**, **1908**, at **8.30** p.m., there will be a Ballot for the election of Fellows, and the following papers will be communicated:

"The action of thionyl chloride and of phosphorus pentachloride on the methylene ethers of catechol derivatives." By G. Barger.

"The preparation of conductivity water." By H. Hartley, N. P. Campbell, and R. H. Poole.

"Derivatives of *p*-diazoiminobenzene." By G. T. Morgan and Miss F. M. G. Micklethwait.

"A study of the diazo-reaction in the diphenyl series." By G. T. Morgan and Miss F. M. G. Micklethwait.

"Organic derivatives of silicon. Part VI. The optically active sulphobenzylethylpropylsilicyl oxides." By F. S. Kipping.

"A simple manometer for vacuum distillation." By N. L. Gebhard.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Thursday, February 20th, 1908.

Andreae, Edward Philip,

"Crestalba," Champion Hill, S.E.

Chemist. Ph.D. (Berlin). Dissertation: "Ueber Chitonsäure u. Chitarsäure." Ueber die Einwirkung von Diaethylmalonylchlorid auf Einige Diamine.

R. W. Sindall. R. H. Aders Plimmer.
Otto Oberländer. E. Frankland Armstrong.
J. C. Cain.

Barr, Guy,

79, Fillebrook Road, Leytonstone, N.E.

Assistant in the Chemical and Metallurgical Department, National Physical Laboratory. Scholarship at Christ's College, Cambridge, 1903. B.A. of Cambridge. First Class in both parts of Natural Sciences Tripos: Pt. I, 1906; Pt. II (Chemistry), 1907. B.Sc. of London; Honours in Chemistry, Second Class, 1907. With Dr. H. J. H. Fenton, paper: "Colour Reactions of some Organic Acids," Cambridge Philosophical Society, 1907.

W. J. Sell. H. O. Jones.
H. J. H. Fenton. C. T. Heycock.
G. D. Liveing.

Barton, Robert, junior,

48, Wellclose Mount, Leeds.

Analytical Chemist. Four (4) years as Pupil and Assistant to

Mr. T. Fairley, F.I.C., F.C.S., City and County Analyst, Leeds. Three (3) Sessions at the late Yorkshire College, Leeds. Three and a-half (3½) years, Assistant Chemist with Messrs. Lever Bros., Ltd., Port Sunlight, Cheshire. At present, Assistant to Mr. G. W. Slatter, A.R.C.Sc., F.I.C., F.C.S., Northern Counties Laboratories, Dock Street, Leeds.

G. W. Slatter.	B. A. Burrell.
Thomas Fairley.	J. B. Cohen.
Arthur Smithells.	*W. Lowson.*

Braun, Marie Joseph Arsène, Ph.D.,
5, Aspinall Road, Brockley, S.E.

Chemist at the South-Metropolitan Gas Co. Technical and scientific diplomas of the "Städtische Chemieschule" at Mülhausen i/Els. 1897—98 Assistant to Prof. E. Noelting at the same school. Ph.D., Basle, 1899. 1899—02 Assistant to Dr. J. Tcherniac at Freiberg, i/Br. 1902—04 Chemist at the "Fabriques de Produits Chimiques" at Mülhausen i/Els. 1904 to present date at the South Metropolitan Gas Co. Publications: "Weitere Untersuchungen über die Bildung von Indazolen," Thesis, Basle, E. Birkhäuser; "Einige Derivate des Acetophenons," Thesis, Basle, E. Birkhäuser; E. Noelting, A. Braun, and G. Thesmar: "Nitro- und Brom-derivate der Xylidine," *Ber.*, **34**, 2242; H. Rupe, A. Braun, and K. von Zembruski: "Ueber einige Abkömmlinge des Acetophenons," *Ber.*, **34**, 3522; A. Braun and J. Tcherniac "Ueber die Produkte der Einwirkung von Acetanhydrid auf Phthalamid," *Ber.*, **40**, 2709.

J. Tcherniac.	Edward Evans.
Otto Oberländer.	*J. C. Cain.*

R. W. Sindall.

Brown, Harry James,
Pembrey Lead Works, Burry Port.

Assayer and Analytical Chemist (at present Chemist to Messrs. Rowe Bros. & Co., Ltd., and Manager of their White Lead Works). Received training at J. S. Merry & Co.'s Assay Office, Swansea, 1888—1891. Assistant Chemist to Elliotts Metal Co., Ltd., 1891—1897. Established Assay Offices and Ore Purchasing Yards for E. M. Co., Ltd., in Mexico and Spain, 1897—1899. Chemist to "Otavi Mining Expedition," G.S.W. Africa, 1900—1901. Engaged as above from 1902 to date. Honours Certificates in Chemistry and Metallurgy (S. K.), and Teacher for three years.

Clarence A. Seyler.	T. C. Davison.
W. R. Bird.	F. W. Harris.

Basil Wm. Valentin.

Brown, Walter, jun.,
Brookvale, Strathaven, N.B.

Analytical Chemist. Studied Chemistry first under J. McCutcheon, F.C.S., Lecturer in Chemistry to the County of Lanark. Served two years' Chemical Apprenticeship to Prof. J. R. Watson, obtaining Elem. and Adv., Theor. and Prac. Science and Arts Cert. in Organic and Inorganic Chemistry; followed by two years in the University of Leipzig. For over two years Chief Assistant to Prof. J. R. Watson, Public Analyst for Irvine, &c.; also taking active part in Saturday Classes for Teachers and Contin. Classes, held at Anderson's College, Glasgow. Since January, 1907, Chemist (temporary) responsible for all analytical work in the Public Health Laboratory of the County of Lanark.

James McCutcheon. Fred. D. S. Robertson.
Frank W. Young. H. T. Calvert.
John Glaister.

Carpenter, John Arthur,
New College, Oxford.

Demonstrator in Chemistry. Scholar of New Coll., Oxford; at present Demonstrator, Christ Church, Oxford. First Class London Int. Sci., 1907, in Chemistry and Physics. First Class Honour Moderations (Maths.), Oxford, 1904. First Class Final Honours Chemistry, 1906. Second Class Final Honours Physics, 1907. Bachelor of Arts.

H. Brereton Baker. Allan F. Walden.
Andrea Angel. D. H. Nagel.
W. H. Lewis.

Clarke, Hans Thacher,
Gayton Corner, Harrow.

Chemist. Chemical Student, University College, London.

J. Norman Collie. Samuel Smiles.
William Ramsay. Edward C. Cyril Baly.
N. T. M. Wilsmore.

Collier, William Henry,
13, Powis Gardens, Bayswater, W.

Teacher of Chemistry. Int. B.Sc. (London University). Teacher at Regent Street Polytechnic (5 years). Six years at College and on the staff of the Merchant Venturers' Technical College, Bristol. Working for B.Sc. exam. of London Univ. (Honours Deg. in Chemistry). Joint author with H. R. Ellis, F.C.S., B.Sc., of paper submitted to Chem. Soc. last month.

J. C. Crocker. Frank E. Weston.
H. R. Ellis. F. H. Lowe.
J. B. Coleman.

Crichton, David Cowan,
Backhill House, Musselburgh.

Manager to Caledonian Portland Cement Co., Cousland, Dalkeith. Degrees held: Master of Arts (St. Andrews); Bachelor of Science (St. And.); Associate of the Institute of Chemistry (London). Papers published: "Electrolysis of Potassium Ethyl Dipropylmalonate" (*Journal of Chem. Soc.*); "Alkyl Ammonium Hydrates" (*Journal of Chemical Society*).

James Walker. J. H. Wigner.
John S. Lumsden. John Foggie.
Charles Spackman.

Dickinson, Cyril,
"Abbotsford," Hollycroft Avenue, Hampstead.

Analytical Chemist. B.Sc. (Vict. and Leeds); F.I.C. Three years under Prof. Smithells at Leeds University. Assistant Chemist, Bradford Dyers' Association. Head Assistant to J. Kear Colwell, Esq., F.I.C., F.C.S.; at present Senior Assistant to Dr. W. Scott Tebb (Borough Analyst for Southwark), with whom I have been for the last 4 years.

Arthur Smithells. J. Kear Colwell.
J. B. Cohen. H. D. Law.
F. Mollwo Perkin.

Eagles, Edwin Mortimer, M.A. Cantab.
5, Winsham Grove, Clapham Common, S.W.

Senior Science Master, Battersea Grammar School (since Easter, 1902). Eight years Science Master, Central Foundn. School of London; 10 years Head of Science Dept., Willesden Polytechnic. In conjunction with Mr. M. M. Pattison Muir, I carried out original work on "Thiohaloid Compounds of Bismuth" (*Jour. Chem. Soc.*, 1895).

M. M. Pattison Muir. A. Hutchinson.
Kennedy J. P. Orton. *A. E. Bellars.*
S. Ruhemann. *H. J. H. Fenton.*

Gale, Robert Cecil,

38, Scarsdale Villas, Kensington.

Student. Advanced Student of Chemistry at the Central Technical College, Exhibition Road, S.W.

Henry E. Armstrong. Gerald T. Moody.
William A. Davis. William Robertson.
T. Martin Lowry.

Heron, John Maxwell,

North House, Manningtree, Essex.

Brewers' Chemist. Chemist to Messrs. Free, Rodwell & Co., Maltsters, Mistley, Essex. Seven years Assistant to John Heron, 110, Fenchurch Street. Last three years Chemist to Messrs. Hole & Co., Castle Brewery, Newark-on-Trent.

Horace T. Brown. John Heron.
Leonard Temple Thorne. Chas. Geo. Matthews.
George Harrow.

Hilditch, Thomas Percy,

4, Park Hall Place, East Finchley, N.

Research Student and Demonstrator, University College, London. Student for three years and Demonstrator in Chemistry for the past two sessions at University College. Have published several papers in the Society's Journal in conjunction with Prof. J. N. Collie, Dr. S. Smiles, and Mr. A. E. Dunstan.

William Ramsay. N. T. M. Wilsmore.
J. Norman Collie. A. W. Stewart.
Edward C. Cyril Baly. A. E. Dunstan.
Samuel Smiles. P. C. Austin.

Merrick, Arnold,

66, Rothbury Terrace, Newcastle-on-Tyne.

Schoolmaster. Teaching Chemistry and Physics. Late Johnston Scholar, University of Durham (College of Science, N/C).

P. Phillips Bedson. S. Hoare Collins.
F. C. Garrett. Herbert Blair.
J. T. Dunn.

Morewood, Capel Darcy,

Ferndale, Frodingham, Doncaster.

Analytical Chemist. I was engaged from February to May, 1906, in Metallurgical and Analytical work in Mr. Seyler's Laboratory, Swansea, where I paid special attention to the micrographic examination of iron and steel. From June to December, 1906, I was on the staff of Messrs. Ed. Riley, City Road, London. From then till now, I have been in entire charge of the laboratory at Lord St. Oswald's Ironstone Mines, Frodingham.

John W. Bevan. Edwd. Riley.
Clarence A. Seyler. *F. J. Bloomer.*
Carl Langer.

Oke, Alfred William, B.A., LL.M., F.G.S., F.L.S. (Trinity College, Cambridge).

32, Denmark Villas, Hove, and Orielton, Highfield Lane, Southampton.

Solicitor. Worked at Cambridge University Laboratory. Am anxious to keep up my knowledge and interest in the subject and its developments.

Alfred C. Young. W. J. A. Butterfield.
J. Brierley. *W. J. Sell.*
H. J. H. Fenton.

Pingriff, George Neville,

39, Hall Road, Handsworth, Staffs.

Chemistry master at the Central Secondary School, Birmingham. Above and similar temporary post at Wyggeston School, Leicester. 1st Class Natural Science Tripos, Part I., Cambridge, 1906; 2nd Class Natural Science Tripos, Part II., Chemistry, 1907.

F. H. Neville. W. J. Sell.
H. J. H. Fenton. H. O. Jones.
Lionel M. Jones.

Pinnock, Douglas Robert,

"St. Patrick's," 31, The Gardens, E. Dulwich, S.E.

Student. Advanced Student in Chemistry at the City and Guilds College, S. Kensington.

Henry E. Armstrong. Gerald T. Moody.
William Robertson. William A. Davis.
Robert J. Caldwell.

Runeckles, Arthur Robert,

68, Kyrle Rd., New Wandsworth, S.W.

Advanced Student in Chemistry at the Central Technical College, S. Kensington. Clothworkers' Scholar and Bancrofts' Exhibitioner.

Henry E. Armstrong. Gerald T. Moody.
William A. Davis. Robert J. Caldwell.
T. Martin Lowry.

Scott, Andrew L.,

Fir Lodge, Cheshunt, Herts.

Analytical Chemist. Official Address: Royal Gunpowder Factory, Waltham Abbey, Essex. Assistant to R. R. Tatlock, Esq., F.R.S.E., &c.; Assistant to Benedict Kitto, Esq. F.I.C., &c. Chemist in Charge of Nitroglycerine Department, Royal Gunpowder Factory. Fellow of the Institute of Chemistry.

Wm. Rintoul.
R. R. Tatlock.
R. T. Thomson.
J. A. Williamson.
Geo. W. MacDonald.
Wm. T. Thomson.
G. H. Welsford.
John Shields.

Shaw, William Bayliss,

Lonsdale House, Walsall.

Undergraduate. Student of Chemistry in the University of Oxford.

W. W. Fisher.
John Watts.
Allan F. Walden.
F. L. Overend.
J. E. Marsh.

Smythe, John Armstrong,

15, The Poplars, Gosforth, Newcastle-on-Tyne.

Lecturer in Chemistry, Armstrong College, Newcastle. Author of following papers: "Ueber das Nitrosopinen," *Inorg. Diss. Göttingen*, 1898. "The Bases contained in Scottish Shale Oil" (with F. C. Garrett), Part I., *Journ. Chem. Soc.*, **81**, 449; Part II., *Journ. Chem. Soc.*, **83**, 763, and of others connected with Chemical Geology.

P. Phillips Bedson.
F. C. Garrett.
S. Hoare Collins.
Herbert Blair.
J. T. Dunn.

Spiers, Charles Sedgley,

The Woodlands, Scalford Road, Melton Mowbray.

Chemist. Interested in chemical manufactures, and anxious to keep in touch with the latest chemical research. Member of the Pharmaceutical Society, and have studied Science under Mr. F. A. Hillard, B.A. (late Wyggeston Grammar School), and the late Mr. Watson-Will, F.C.S., Metropolitan College of Pharmacy.

Harry Lucas.
David J. Williams.
F. Filmer De Morgan.
Frederick B. Power.
Thomas Tyrer.

Stead, Arthur,

113a, Kellner Street, Bloemfontein, O.R.C.

Assistant to Govt. Analyst and Bacteriologist of the O.R.C. since Oct., 1904; Senior Norfolk County Council Scholarship (1895—

1900); B.Sc. (Victoria). First Class Ordinary Degree in Chemistry and Physics, and "Studentship," Univ. College, Liverpool, 1899. Education Department, Heidelberg, Transvaal, 1902—1904.

J. Campbell Brown.	J. Handby Ball.
A. W. Titherley.	John S. Smythe.

W. Collingwood Williams.

Trechmann, Adolph Octavius,
The Old Palace, Rochester,

Cement Manufacturer. Studied Chemistry under Sir Henry Roscoe and Professor Dixon at Owens College from 1884—1888. Managing Director of the Cement Works of Trechmann, Weekes & Co., Limited, of Halling, near Rochester, Kent. A member of the Society of Chemical Industry since 1888.

Alfred Gordon Salamon.	Thos. Tyrer.
Arthur W. Crossley.	Boverton Redwood.
Walter F. Reid.	*Louis J. Riley.*

William Ramsay.

Tyson, Thomas Marshall,
99, Sebert Road, Forest Gate, E.

Analytical Chemist in a works laboratory. I have had three years' training under Mr. J. S. Remington, Aynsome Analytical and Technical Laboratories. Mr. Remington then engaged me as an Assistant at his laboratories, and finally got me my present position as Works Chemist. I am also continuing my studies at the West Ham Technical Institute night classes.

John Stewart Remington.	W. Ormston Young.
Claude Smith.	*George Dean.*

F. Henry Streatfeild.

Unwin, Harry Jackson,
Market Place, Clay Cross, nr. Chesterfield.

Science Teacher. Laboratory Assistant and Teacher of Chemistry for 8 years in Secondary Schools. Trained at Royal College of Science. South Kensington Certificates: Adv. Prac. Inorg. Chemistry, 1st Class; Adv. Theor. Inorg. Chemistry, 1st Class.

Fredk. Cowling.	W. E. Jennings.
A. H. Salway.	*Harold Rogerson.*

Frank Tutin.

Wade, Alfred,
Fiji.

Government Pharmacist. For six years with Messrs. Reynolds & Branson, Leeds, Scientific Apparatus Manufacturers, &c. Passed

Minor Examn. (Pharmaceutical Society), 1903, and Major in 1904. Certificate of Honour and Silver Medal for Chemistry, 1904—6. Assistant Manager and Analyst to Messrs. Willows, Francis, Butler, and Thompson, Ltd., Manufacturing Chemists. Now Government Pharmacist, Fiji.

W. Palmer Wynne. Frank Wade.
F. W. Branson. *Thomas Fairley.*
J. H. Gough. *B. A. Burrell.*

Walker, Herbert,
"Whyttington," Station Road, Wealdstone, N.W.

Civil Engineer and Surveyor to the Urban District Council, Wealdstone. Course of Study at Midland Institute, Birmingham, and at Mason's College, Birmingham. Science Teacher at Technical School, Corporation of Smethwick.

William A. Colebourn. J. Wilson.
C. Sordes Ellis. *J. Hart-Smith.*
Frank E. Weston.

Watson, Herbert Edmeston,
Tringhurst, Cranes Park, Surbiton.

Research Student at University College. Demonstrator 2 years at University College. B.Sc.; 1st Class Honours in Chemistry.

William Ramsay. Samuel Smiles.
Edward C. Cyril Baly. N. T. M. Wilsmore.
A. W. Stewart.

Watson, John,
5, Kendrew St., Darlington.

Science Teacher. Bachelor of Science (Armstrong College, Newcastle). Assistant Lecturer in Agricultural Chemistry, Armstrong College, Newcastle.

P. Phillips Bedson. S. Hoare Collins.
F. C. Garrett. Herbert Blair.
G. P. Dodds. *W. F. Keating Stock.*
J. W. Patterson.

Williams, David Thomas,
9, Calvert Terrace, Swansea.

Analytical and Metallurgical Chemist. Student and Assistant Chemist for 5 years at Landore Iron & Steel Wks. (now Baldwin's, Ltd.). Fifteen years at Messrs. Elliott's Metal Co., Burry Port, the last six years of which as Chief Chemist. Honours Certificate S. K. Chemistry and Metallurgy, and had charge of Technical Classes for

4 years. Contributed note on "Estimation of Vanadium" (*Soc. Chem. Indus.*, 1902).

Clarence A. Seyler.
T. C. Cloud.
Arthur C. Claudet.
Frank B. Last.
F. W. Harris.

Williams, Joseph Henry,

"The Briars," 27, Canbury Avenue, Kingston-on-Thames.

Assistant Manager of Chemical and Pharmaceutical Laboratories Late Assistant to A. E. Bell, Esq., F.I.C. Member of the Pharmaceutical Society. Author of "Note on the Solubility of β-Eucaine Hydrochloride"; "An Important Method for the Preparation of Alcoholic Extracts." (Both of these papers were published in the *Pharmaceutical Journal.*)

Albert E. Bell.
John B. Tillott.
Francis Henry Wall.
William Robertson.
T. W. Firth Clark.

Wilson, Harry Percy,

3, Audley Rd., Colchester.

Science Superintendent, Technical and University Extension College, and Senior Chemical Lecturer, Colchester. Lecturer and Teacher of Analytical Chemistry, chiefly inorganic work connected with the engineering industry of Colchester, and with the gases required for gas-engines.

Arthur W. Nunn.
J. Cardew Bedwell.
Jos. Cowper.
T. B. Wood.
J. E. Purvis.

Withey, William Henry,

Stroud, Glos.

B.A. (Cantab.); 1st Class Honours, Part I, Natural Sciences Tripos (1905); 2nd Class Honours, Part II, do. (Chemistry), 1906. For twelve months in laboratory of Dr. S. Rideal, F.C.S., F.I.C.

W. J. Sell.
Samuel Rideal.
H. J. H. Fenton.
H. O. Jones.
G. Nevill Huntly.

Wood, Francis Charles Benjamin,

Deurne, near Antwerp, Belgium.

Technical Chemist. At present managing Dye Works. Student Royal Technical Institute, Salford, for 2—3 years; Chemist and Colourist at Leopold, Cassella and Co., Frankfort. Wishes to remain in contact with current English chemical literature.

J. R. Appleyard.
E. Clark.
B. Prentice.
E. J. Wilkinson.
Ad. Liebmann.
J. C. Cain.

Yates, Joseph,

18, Park Street, Haslingden, Lancs.

Lecturer in Chemistry. Certificate in Applied Chemistry, Owens College, Manchester, 1899. Joint author of following papers: "Action of Aluminium Chloride on Camphoric Anhydride," *Trans.*, 1901, 1373; "Brazilin and Hæmatoxylin," *Trans.*, 1901, 1373, *Trans.*, 1902, 235; "Optically Active Reduced Naphthoic Acids," *Trans.*, 1906, 1101; "Relative Catalytic Effect of Bases on Optically Active Reduced Naphthoic Acids," *Trans.*, 1906, 1484.

Harold B. Dixon. Robert H. Pickard.
W. H. Perkin. J. F. Thorpe.
W. E. Bickerdike.

The following Certificates have been authorised by the Council under Bye Law I (3):

Collens, Archibald Edgar,

Port of Spain, Trinidad, B. W. Indies.

Laboratory Assistant and Chemical Demonstrator, Government Laboratory, Trinidad. Permanently employed at the Government Laboratory from March, 1900. Lecturer on Agricultural Science to Government Training Colleges from July 1, 1902, to March 31, 1905. Acting Science Master to Queen's Royal College, St. Mary's College, and Government Training Colleges from March 8, 1906, to June 12, 1906; and from August 27, 1907, continuing. Acting Professor of Chemistry to Queen's Royal College and St. Mary's College from September 11, 1907, to October 26, 1907. Acting Assistant Analyst, Government Laboratory, from August 14, 1904, to November 22, 1904; and from March 8, 1906, to June 12, 1906. Foreign Member, American Chemical Society (elected April, 1906).

P. Carmody. Joseph de Verteuil.
John G. Ferrier.

Francies, Joseph Valentine,

Sibpur, Calcutta, India.

Head Master, Civil Engineering College, and Lecturer in Chemistry. Instructor in Science, &c., Thomason C. E. College, Roorkee, from 1897 to 1905. Lecturer in Chemistry, C. E. College, Calcutta, since 1905.

E. R. Watson. P. P. Phillips.
Paul Brühl. *J. A. Cunningham.*

Singh, Puran,
Dehra Dun, India.

Acting Imperial Forest Chemist. Member of the Pharmaceutical and Chemical Societies of Japan. Late Research Scholar of Dr. Wilhelm Nag Nagai, Ph.D. (Berlin). Author of "Researches on Cantharidine—its extraction and determination" and "The Estimation Catechin." Acting Imperial Forest Chemist to the Government of India.

M. C. Nanjunda Row. *M. Goolab Roy.*

R. CLAY AND SONS, LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 28/2/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 337.

Thursday, February 20th, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

The President announced that letters have been received from those gentlemen recently elected Honorary and Foreign Members, acknowledging the honour which the Society desired to pay them.

Certificates were read for the first time in favour of Messrs. :

Albert Edward Findley, B.Sc., 1, Welford Road, Handsworth, Birmingham.
George Edward Holden, 23, Durnford Street, Middleton, Manchester.
Percy Hulme Hornby, 111, Nine Elms Lane, S.W.
Herbert Mansfield, B.Sc., A.I.C., 70, Stapleton Hall Road, Stroud Green, N.

Certificates have been authorised by the Council under Bye-Law I (3) in favour of Messrs. :

Bidhu Bhushan Dutt, M.A., Presidency College, Calcutta.
Atul Chandra Gañguli, B.A., Ravenshaw College, Cuttack, India.
Arthur Horrobin, Ajmer, Rajputana, India.
Pañchānan Neogi, Rajshahi College, Rajshahi, Bengal.

It was announced that the following changes in the Officers and Council were proposed by the Council:

Vice-Presidents to retire: Prof. A. Smithells and Prof. W. P. Wynne.

Ordinary Members of Council to retire: Mr. E. C. C. Baly, Dr. Bernard Dyer, Mr. E. Grant Hooper, and Dr. G. T. Moody.

As President: Sir William Ramsay.

As Vice-Presidents who have filled the office of President: Prof. H. E. Armstrong, Prof. A. Crum Brown, Sir William Crookes, Sir James Dewar, Dr. A. G. Vernon Harcourt, Prof. R. Meldola, Dr. H. Müller, Prof. W. Odling, Prof. J. Emerson Reynolds, Sir Henry E. Roscoe, Dr. W. J. Russell, Prof. T. E. Thorpe, and Prof. W. A. Tilden.

As Treasurer: Dr. Alexander Scott.

As Secretaries: Dr. M. O. Forster and Prof. A. W. Crossley.

As Foreign Secretary: Dr. Horace T. Brown.

As Vice-Presidents: Prof. J. Campbell Brown, Prof. J. J. Dobbie, Prof. F. S. Kipping, Dr. R. Messel, Sir A. Pedler, and Prof. W. H. Perkin.

As New Ordinary Members of Council: Mr. J. L. Baker, Mr. A. C. Chapman, Prof. J. B. Cohen, and Dr. J. T. Hewitt.

Dr. A. Harden, Dr. H. Forster Morley, and Dr. J. A. Voelcker were elected Auditors to audit the Society's Accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared elected:

Edward Philip Andreae, Ph.D.
Guy Barr, B.A., B.Sc.
Robert Barton, jun.
Marie Joseph Arsène Braun, Ph.D.
Harry James Brown.
Walter Brown, jun.
John Arthur Carpenter, B.A.
Hans Thacher Clarke.
Archibald Edgar Collens.
William Henry Collier.
David Cowan Crichton, M.A., B.Sc.
Cyril Dickinson, B.Sc.
Edwin Mortimer Eagles, M.A.
Joseph Valentine Francies.
Robert Cecil Gale.
John Maxwell Heron.
Thomas Percy Hilditch.
Arnold Merrick.
Capel Darcy Morewood.
Alfred William Oke, B.A., LL.M.
George Neville Pingriff, B.A.
Douglas Robert Pinnock.
Arthur Robert Runeckles.
Andrew L. Scott.
William Bayliss Shaw.
Puran Singh.
John Armstrong Smythe.
Charles Sedgley Spiers.
Arthur Stead, B.Sc.
Adolph Octavius Trechmann.
Thomas Marshall Tyson.
Harry Jackson Unwin.
Alfred Wade.
Herbert Walker.
Herbert Edmeston Watson, B.Sc.
John Watson, B.Sc.
David Thomas Williams.
Joseph Henry Williams.
Harry Percy Wilson.
William Henry Withey, B.A.
Francis Charles Benjamin Wood.
Joseph Yates.

Of the following papers, those marked * were read:—

*32. "Organic derivatives of silicon. Part VI. The optically active sulphobenzylethylpropylsilicyl oxides." By Frederic Stanley Kipping.

The sulphonic acids obtained by resolving *dl*-sulphobenzylethylpropylsilicyl oxide with one of the active methylhydrindamines (*Trans.*, 1907, **91**, 209) have been further studied, and the results clearly show that the two acids are optically active, enantiomorphously related compounds having the constitution

$$(SO_3H\cdot CH_2\cdot C_6H_4\cdot SiEtPr)_2O\,;$$

although they contain two asymmetric silicon groups, their specific rotations are very small, the values obtained for the sodium salts being $[\alpha]_D \pm 5{\cdot}8—5{\cdot}9°$.

The crystalline *dAdB*- and *lAlB*-methylhydrindamine derivatives differ very widely in outward properties from the *dAlB*- and *lAdB*-compounds, which have a very gelatinous or horny nature, but all four salts have a specific rotation $[\alpha]_D \pm 15—16°$ in methyl-alcoholic solution.

The *dAlB*- and *lAlB*-menthylamine salts are practically indistinguishable from one another or from the salt of the *dl*-acid, and this is also true in the case of the corresponding three *d*-bornylamine derivatives; the cinchonidine and cinchonidine hydrogen salts of the two active acids differ slightly in melting point.

dl-Sulphobenzylethylpropylsilicyl oxide is decomposed by hot concentrated sodium hydroxide, giving *p*-toluenesulphonic acid.

*33. "The preparation of conductivity water." By Harold Hartley, Norman Phillips Campbell, and Reginald Holliday Poole.

The efficiency of different methods of preparing conductivity water has been investigated in order to find a trustworthy way of obtaining water with a specific conductivity not greater than 1 gemmho ($1{\cdot}0 \times 10^{-6}$ reciprocal ohms) in a chemical laboratory under ordinary conditions. By combining several devices in use in other laboratories, a still has been constructed which in one operation gives a fair yield of water with a conductivity 0·75 gemmho at 18°, starting from ordinary distilled water with a conductivity of 5 gemmhos without any preliminary chemical treatment. The distillation can be carried out in a chemical laboratory where nothing is done to keep the air specially free from impurities.

Discussion.

Dr. T. M. Lowry congratulated the authors on being able to produce water of such low conductivity under ordinary laboratory conditions. The still described by Mr. Bousfield (*Trans.*, 1905, **87**, 740) gave almost equally good water (after boiling in a platinum flask, values as low as 0·45 gemmho had been obtained), and had the advantage that it could be left running without attention for a month at a time, but the quality of the water deteriorated when the still was worked in an impure atmosphere, unless special precautions were taken to protect the distillate. It was now generally recognised that the air rather than glass or metal vessels was the most dangerous source of contamination; "gemmho" water could be stored for many months without deterioration in the large green bottles in which the Welsbach solutions were imported, and which could be purchased through the ordinary trade channels; on the other hand, water of lower conductivity did not usually repay the trouble involved in its preparation, since it deteriorated so rapidly in contact with air that it was likely (by giving a false impression of its actual purity) to introduce rather than eliminate an error in conductivity measurements.

Dr. Philip asked whether, in view of the fact that a Jena glass flask was found suitable for storing the pure water, the metal parts of the condenser might not be replaced by Jena glass apparatus.

In answer to Dr. Philip, Mr. Hartley said that very good results had been obtained with a Jena glass condenser, but a block tin tube was better, as it produced more rapid condensation, and could be soldered into the condensing vessel, avoiding the use of corks which required frequent renewal.

*34. "Derivatives of para-diazoiminobenzene." By Gilbert Thomas Morgan and Francis Mary Gore Micklethwait.

It has been shown that the explosive diazoimino-derivative obtained by Hantzsch from phenyl-*p*-phenylenediamine (*Ber.*, 1902, **35**, 895) belongs to the same group of compounds as the stable arylsulphonyl-*p*-diazoimides prepared by the authors. A series of substances connecting this unstable *p*-diazoimino with the *p*-diazoimides has been obtained by a study of the diazo-derivatives of 2 : 4 : 6-trinitrophenyl-*p*-phenylenediamine, 2 : 4-dinitrophenyl-*p*-phenylenediamine, 4-nitrophenyl-*p*-phenylenediamine, and 2-nitrophenyl-*p*-phenylenediamine.

The first of these bases, which contains a substituent comparable in acidic character to the acyl groups in the arylsulphonyl-*p*-diamines, furnishes a stable *p*-diazoimino-derivative similar in its properties to the arylsulphonyl-*p*-diazoimides, and produced under comparable conditions by the action of sodium acetate on the diazo-salt of 2 : 4 : 6-trinitrophenyl-*p*-phenylenediamine.

The diazo-salts of 2 : 4-dinitrodiphenyl-*p*-phenylenediamine give rise to a diazoimine only when treated with potassium hydrogen carbonate, but not with aqueous sodium acetate. The product is more explosive than the trinitro-derivative.

The diazo-salts of 2- and 4-nitrophenyl-*p*-phenylenediamine do not yield diazoimines either with an alkali acetate or carbonate, but only on treatment with ammonia is the condensation product obtained. In this respect, these bases behave like phenyl-*p*-phenylenediamine itself.

These results show that the ease of formation and the stability of the derivatives of the hypothetical *p*-diazoiminobenzene are determined by the acidic nature of a substituent attached to one aminic nitrogen.

DISCUSSION.

Dr. GEORGE YOUNG pointed out that five-atom carbon-nitrogen rings differ markedly in their nature, and especially in regard to their stability, from heterocyclic nuclei containing either a greater or smaller number of atoms in the ring. Hence arguments based on a comparison of the *p*-diazoiminobenzenes with compounds such as *o*-diazoiminobenzene or Wolff's derivative of tetronic acid, which contain five-atom rings, cannot be decisive as between the benzenoid constitution discussed by Dr. Morgan, in which there is a seven-atom and the quinonoid formula with its three-atom heterocyclic grouping.

DR. MORGAN, in reply to Dr. Hewitt, said that in conjunction with Mr. E. G. Couzens he had made many attempts to prepare diazoimides of the meta-series from the benzenesulphonyl-*m*-diamines of benzene, toluene, *m*-xylene, and mesitylene. Being entirely unsuccessful, they inferred that the diazoimide condensation was not wholly a matter of internal salt formation, and that the change occurred only when this factor was reinforced by the tendency for ring formation which characterises the ortho- and para-derivatives as distinguished from the meta-series. The picryl-*p*-phenylenediazoimine closely resembled the para-diazoimides, and it seemed only reasonable to suppose this compound also owed its existence to the combined operation of these salt and ring-forming tendencies.

With regard to the point raised by Dr. Cain in reference to the validity of analogies concerning the constitutions of ortho-, para-, and peri-derivatives based on experimental evidence obtained from the last of these three series, it seemed to him that this testimony was greatly to be preferred to that derived from a comparison instituted between substances so very dissimilar as *p*-aminophenol and α-aminotetronic acid.

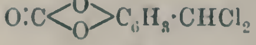
*35. "The affinity constants of bases as determined by the aid of methyl-orange." By Victor Herbert Veley.

The author has extended the work of which a preliminary account has already appeared (*Proc.*, 1907, **23**, 284).

Results were given for the hydrochlorides of (i) bases not containing an alkyl grouping; (ii) aliphatic amines; (iii) aminoacetic acids, and (iv) uric acid derivatives. As regards hydrazine in (i), and all cases of (iii), it was shown that the results obtained by the methyl-orange method are concordant with those obtained by the electric conductivity method, although the dilutions were about forty to eighty times greater. The tentative conclusion was drawn that either there is a limiting value of V in the Arrhenius equation $K_b/K_w = (1 - x)V/x^2$, or that the hydrolytic reaction becomes reversible. As regards cases of (iv), the general agreement of the results obtained by the methyl-orange method with those of the solubility method was considered, although the increase of hydrolysis relative to dilution is less than that required by Arrhenius' formula.

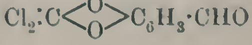
36. "The action of thionyl chloride and of phosphorus pentachloride on the methylene ethers of catechol derivatives." By George Barger.

In the chloro-compounds, formed by heating the methylene ethers of catechol derivatives with phosphorus pentachloride, the most labile chlorine atoms are those introduced into the methylene group. By the action of water or of glacial acetic acid at low temperatures, this pair of chlorine atoms is replaced by an oxygen atom, with the formation of a cyclic carbonate. The "dichlorpiperonal" of Fittig and Remsen (*Annalen*, 1871, **159**, 144) is therefore the cyclic carbonate of 3:4-dihydroxybenzylidene chloride (I), and does not possess an aldehyde group as implied by the present formula (II).



$\mathrm{O{:}C}\!<\!\begin{smallmatrix}\mathrm{O}\\ \mathrm{O}\end{smallmatrix}\!>\!\mathrm{C_6H_3{\cdot}CHCl_2}$

(I.)



$\mathrm{Cl_2{:}C}\!<\!\begin{smallmatrix}\mathrm{O}\\ \mathrm{O}\end{smallmatrix}\!>\!\mathrm{C_6H_3{\cdot}CHO}$

(II.)

Similarly, the supposed chloro-acid, obtained by Fittig and Remsen from piperonylic acid in an impure condition, is in reality the cyclic carbonate of protocatechuoyl chloride or carbonyldioxybenzoyl chloride, $\mathrm{O{:}C{:}O_2{:}C_6H_3{\cdot}COCl}$.

Heating with excess of thionyl chloride to 180° has the same effect as phosphorus pentachloride and water, so that cyclic carbonates are formed directly from the methylene ethers.

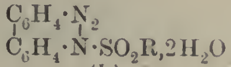
3 : 4-*Carbonyldioxybenzoyl chloride* boils at 166—167°/12 mm., and crystallises from a mixture of benzene and light petroleum in stout crystals melting at 68°. Several derivatives were described.

37. "A study of the diazo-reaction in the diphenyl series." By Gilbert Thomas Morgan and Francis Mary Gore Micklethwait.

The arylsulphonylbenzidines, $RSO_2\cdot\overset{*}{NH}\cdot C_6H_4\cdot C_6H_4\cdot NH_2$, furnish yellow, crystalline diazonium salts giving rise, on treatment with aqueous sodium acetate, to dark brown, crystalline compounds which are either monohydrated nitrosoamines,

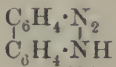
$$R\cdot SO_2\cdot NH\cdot C_6H_4\cdot C_6H_4\cdot NH\cdot NO,H_2O,$$

or dihydrated diazoimides (I) :



$$\begin{array}{l} C_6H_4\cdot N_2 \\ \;| \qquad\;\; | \\ C_6H_4\cdot N\cdot SO_2R,2H_2O \end{array}$$

(I.)

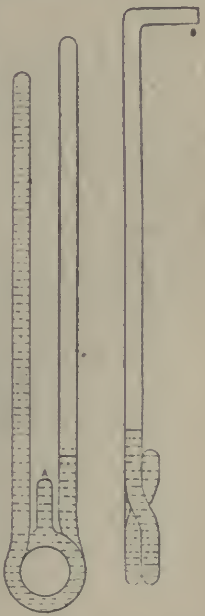


$$\begin{array}{l} C_6H_4\cdot N_2 \\ \;| \qquad\;\; | \\ C_6H_4\cdot NH \end{array}$$

(II.)

In this respect, these acylbenzidines differ from benzidine, which gives rise to a diazoimide (II). The diazonium salts of the arylsulphonylalkylbenzidines, $RSO_2\cdot N(C_2H_5)\cdot C_6H_4\cdot C_6H_4\cdot NH_2$, although distinctly less coloured than those of the unalkylated bases, have nevertheless not been obtained in a colourless condition. There is accordingly no reason for supposing that the diazonium salts of the alkylated bases are differently constituted from those which still contain the labile acidic hydrogen atom (*).

38. "A simple manometer for vacuum distillation." By Norman Leslie Gebhard.



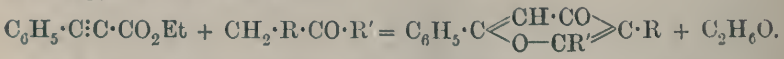
The manometer described consists essentially of a barometer tube bent in the form depicted in the figure. The simple trap *A* prevents effectually any air from being forced back into the barometer tube and thus affecting the readings. In order to remove any air thus trapped, it is merely necessary to incline the apparatus so that the mercury expels the air into the open arm again ; this is, however, only necessary at the end of an operation, as the apparatus is capable of yielding accurate readings in spite of the presence of air in the trap.

39. "Researches on the anthraquinones." By William Henry Bentley and Charles Weizmann.

An account was given of the condensations of: (1) phthalic anhydride and pyrogallol trimethyl ether; (2) hemipinic anhydride and veratrole; (3) hemipinic anhydride and pyrogallol trimethyl ether in presence of aluminium chloride. These reactions yield respectively: (1) *trimethoxybenzoylbenzoic acid*, m. p. 169°; (2) *tetramethoxybenzoylbenzoic acid*, m. p. 193—194°; (3) *hydroxytetramethoxybenzoylbenzoic acid*, m. p. 190°. These acids on further condensation with concentrated sulphuric acid yield respectively: (1) *dihydroxymonomethoxyanthraquinone*, m. p. 235—236°; (2) *hydroxytrimethoxyanthraquinone*, m. p. 226°; (3) *trihydroxydimethoxyanthraquinone*, m. p. 230°. By employing phosphoric oxide in place of sulphuric acid, it was found possible to obtain tetramethoxyanthraquinone (m. p. 239°) from tetramethoxybenzoylbenzoic acid.

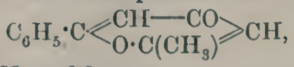
40. "The formation of 4-pyrone compounds from acetylenic acids." Part I. By Siegfried Ruhemann.

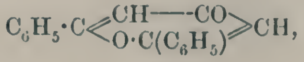
The author finds that ethyl phenylpropiolate condenses with the ketones of formula $R\cdot CH_2\cdot CO\cdot R'$ in presence of sodium ethoxide to form 4-pyrone derivatives thus:



$$C_6H_5\cdot C\vdots C\cdot CO_2Et + CH_2\cdot R\cdot CO\cdot R' = C_6H_5\cdot C\Big<\begin{array}{c}CH\cdot CO\\ O-CR'\end{array}\Big> C\cdot R + C_2H_6O.$$

Up to the present, acetone and acetophenone have been used, and 2-phenyl-6-methyl-4-pyrone, $C_6H_5\cdot C\Big<\begin{array}{c}CH-CO\\ O\cdot C(CH_3)\end{array}\Big> CH$, and 2:6-diphenyl-4-pyrone, $C_6H_5\cdot C\Big<\begin{array}{c}CH-CO\\ O\cdot C(C_6H_5)\end{array}\Big> CH$, respectively, have been obtained.





Along with diphenyl-4-pyrone, there is formed in this reaction a colourless compound, $C_{25}H_{20}O_3$, which yields a violet solution with concentrated sulphuric acid, and is produced according to the equation:

$$C_6H_5\cdot C\vdots C\cdot CO_2Et + 2C_6H_5\cdot CO\cdot CH_3 = C_{25}H_{20}O_3 + C_2H_6O.$$

The formula $C_6H_5\cdot CH_2\cdot CO\cdot CO\cdot C(CO\cdot C_6H_5)\vdots C(CH_3)\cdot C_6H_5$ is suggested for this substance.

41. "The action of mustard oils on the ethyl esters of malonic and cyanoacetic acids." By Siegfried Ruhemann.

Ethyl sodiomalonate reacts with phenyl thiocarbimide, thus: $CHNa(CO_2Et)_2 + C_6H_5\cdot NCS = C_6H_5\cdot N{:}C(SNa)CH(CO_2Et)_2$, and this additive product, with acids, yields diethyl thiocarbanilinomalonate, $C_6H_5\cdot NH\cdot CS\cdot CH(CO_2Et)_2$. This, on hydrolysis with dilute caustic potash, loses 1 molecule of carbon dioxide, forming *thiocarbanilinoacetic acid*, $C_6H_5\cdot NH\cdot CS\cdot CH_2\cdot CO_2H$, which melts at 91—92°, and at the same time evolves carbon dioxide to yield thioacetanilide. The colourless sodium compound of diethyl thiocarbanilinomalonate forms a *benzyl* derivative, which is also colourless, and has the formula $C_6H_5\cdot N{:}C(S\cdot CH_2\cdot C_6H_5)\cdot CH(CO_2Et)_2$.

Ethyl sodiobenzylmalonate and phenyl thiocarbimide do not yield a compound of formula $C_6H_5\cdot N{:}C(SH)\cdot C(CH_2\cdot C_6H_5)(CO_2Et)_2$. This fact would point to a different way of representing the product of the union between ethyl sodiomalonate and phenyl thiocarbimide, but, for the present, the author adheres to the former view.

Ethyl sodiocyanoacetate also combines with phenyl thiocarbimide, and furnishes *ethyl thiocarbanilinocyanoacetate*,

$$C_6H_5\cdot NH\cdot CS\cdot CH(CN)\cdot CO_2Et.$$

This compound is colourless, as are its *sodium* and *ammonium* salts as well as its *benzyl* derivative,

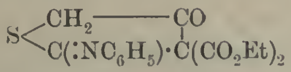
$$C_6H_5\cdot N{:}C(S\cdot CH_2\cdot C_6H_5)\cdot CH(CN)\cdot CO_2Et,$$

but on drying at 100° or on crystallisation from hot solvents it turns yellow. This behaviour is regarded as pointing to the existence of the substance in two tautomeric forms:

$$C_6H_5\cdot N{:}C(SH)\cdot CH(CN)\cdot CO_2Et$$

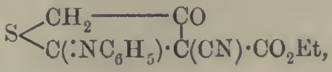
and $C_6H_5\cdot NH\cdot CS\cdot CH(CN)\cdot CO_2Et$.

The action of ethyl chloroacetate on the sodium derivatives of diethyl thiocarbanilinomalonate and of ethyl thiocarbanilinocyanoacetate yields the *cyclic* compounds:



$$S\!<\!\begin{array}{l}CH_2\text{———}CO\\ C({:}NC_6H_5)\cdot C(CO_2Et)_2\end{array}$$

and



$$S\!<\!\begin{array}{l}CH_2\text{———}CO\\ C({:}NC_6H_5)\cdot C(CN)\cdot CO_2Et,\end{array}$$

respectively; these are yellow, but, under the influence of potassium hydroxide, change into colourless isomerides. The nature of these transformations is still under examination.

42. "The triazo-group. Part II. Azoimides of propionic ester and of methyl ethyl ketone." By Martin Onslow Forster and Hans Eduard Fierz.

On comparing the behaviour of the α- and β-triazo-derivatives of ethyl propionate towards alkali, it was found that, whilst the first-named resembles triazoacetic ester, ethyl β-triazopropionate rapidly parts with hydrazoic acid.

α-Triazopropionic acid, $CH_3 \cdot CHN_3 \cdot CO_2H$, is a colourless oil, having a rancid odour, and forms crystals which melt at 0°; the *silver* salt, $C_3H_4O_2N_3Ag$, crystallises from hot water in lustrous needles. The *ethyl* ester, $C_5H_9O_2N_3$, prepared from ethyl α-bromopropionate and sodium azide, boils at 46° under 2 mm. pressure, and has sp. gr. 1·065 compared with water at 23°; the *amide*, $C_3H_6ON_4$, crystallises from benzene in rectangular plates, melting at 79°.

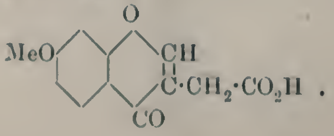
Ethyl-β-triazopropionate, $N_3 \cdot CH_2 \cdot CH_2 \cdot CO_2 \cdot C_2H_5$, prepared from the iodo-ester and sodium azide, boils at 58° under 4 mm. pressure; aqueous ammonia eliminating hydrazoic acid, it has not been possible to prepare the amide and the free acid from this ester.

3-*Triazobutanone*-2, $CH_3 \cdot CO \cdot CHN_3 \cdot CH_3$, produced on agitating the corresponding chloro-derivative of methyl ethyl ketone with aqueous sodium azide, boils at 46° under 2 mm. pressure, and has sp. gr. 1·057 at 18°; the *semicarbazone*, $C_5H_{10}ON_6$, crystallises in snow-white plates, and melts at 94°.

1-*Triazobutanone*-2, $N_3 \cdot CH_2 \cdot CO \cdot CH_2 \cdot CH_3$, boils at 56° under 2 mm. pressure, and has sp. gr. 1·084 at 18°; it resembles the foregoing ketone and acetonylazoimide in its behaviour towards alkali and sulphuric acid. The *semicarbazone*, $C_5H_{10}ON_6$, crystallises in needles, and melts at 101°.

43. "Brazilin and hæmatoxylin. Part VIII. Synthesis of brazilinic acid, the lactones of dihydrobrazilinic and dihydrohæmatoxylinic acids, anhydrobrazilic acid, &c. The constitution of brazilin, hæmatoxylin, and their derivatives." By William Henry Perkin, jun., and Robert Robinson.

The authors have continued and elaborated the work of which a preliminary account has already appeared (*Proc.*, 1907, **23**, 291). Further confirmation of the constitution of the members of this group is afforded by the synthesis of *anhydrobrazilic acid*, which has been proved to possess the formula:



ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bruce, *Edwin M.* Detection of the common food adulterants. pp. vii + 84. London 1907 (*Recd.* 5/2/08.)

From the Publishers: Messrs. Archibald Constable and Co.

Cain, *John Cannell.* The chemistry of the diazo-compounds. pp. xi + 172. London 1908. (*Recd.* 6/2/08.) From the Author.

Melick, *Charles W.* Dairy laboratory guide. pp. v + 129. ill. London 1907. (*Recd.* 5/2/08.)

From the Publishers: Messrs. Archibald Constable and Co.

Woburn Experimental Fruit Farm. Eighth report. By the **Duke of Bedford**, *K.G.*, and *Spencer U.* **Pickering**. pp. iv + 129 + xli. London 1908. (*Recd.* 31/1/08.)

From His Grace the Duke of Bedford, K.G.

II. *By Purchase.*

Carlsberg, Laboratoire de. Comptes Rendus. Vol. 6, etc. Copenhague 1903. (*Reference.*)

Lehmann, *O.* Molekularphysik mit besonderer Berücksichtigung mikroskopischer Untersuchungen und Anleitung zu solchen sowie einem Anhang über mikroskopische Analyse. 2 vols. pp. x + 852, vi + 697. ill. Leipzig 1888—1889. (*Recd.* 16/1/08.)

Young, *Sydney.* Stoichiometry. Together with an introduction to the study of physical chemistry by *Sir William* **Ramsay**. pp. lxi + 381. ill. London 1908. (*Recd.* 23/1/08.)

III. *Pamphlets.*

Cain, *John Cannell.* Dyes and dyeing in the past year. A review. (From the *J. Soc. Dyers*, **23**, 1907.)

Richardson, *Clifford.* A plea for the broader education of the chemical engineer. (From the *Proc. Amer. Assoc. Adv. of Sci.*, **57**, 1908.)

At the next Ordinary Meeting on **Thursday,** March **5th**, 1908, at **8.30** p.m., the following paper will be communicated:

"The solubility of iodine in water." By H. Hartley and N. P. Campbell.

RICHARD CLAY AND SONS, LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 17/3/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 338

Thursday, March 5th, 1908, at 8·30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Messrs. E. de B. Barnett, E. M. Eagles, R. C. Gale, J. M. Heron, C. W. Moore, A. R. Runeckles, H. E. Watson, and J. H. Williams were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Arthur Edward Coverdale, 68, Broad Street, Worcester.
Frederick J. Maywald, 1028, 72nd Street, Brooklyn, N.Y., U.S.A.
Samuel Ernest Melling, The Cliff, Higher Broughton, Manchester.
Edwin John Watkins, 10, Montpelier Road, Queen's Road, Peckham, S.E.

The President read the names of the Fellows recommended by the Council for election as Officers and as Ordinary Members of Council of the Society. It was also announced that the name of Prof. W. Jackson Pope, as Vice-President, and the names of Mr. John Allan and Prof. Adrian J. Brown, as Ordinary Members of Council, had been proposed by other Fellows.

Of the following papers, those marked * were read :—

*44. "The solubility of iodine in water." By Harold Hartley and Norman Phillips Campbell.

The solubility of iodine in water has been determined at 18°, 25° 35°, 45°, and 55°, the value at 25° agreeing very closely with that found by Noyes and Seidensticker. The heat of solution has been calculated from the temperature coefficient of the solubility.

*45. "Nitro-derivatives of *o*-xylene." (Preliminary note.) By Arthur William Crossley and Nora Renouf.

o-Xylene, when treated with a nitrating mixture, readily yields two trinitro-derivatives, which can be separated by means of their different solubilities in concentrated sulphuric acid. Both crystallise from alcohol, in which solvent they are fairly readily soluble, the one in faintly yellow, glistening, flattened needles, melting at 71°, and the other in long, stout, prismatic needles, melting at 115°.

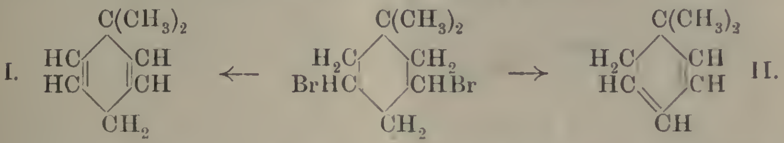
These facts are not in accord with the statement of Noelting and Thesmar (*Ber.*, 1902, **35**, 634), that "*o*-xylene is incapable of yielding a trinitro-derivative even when submitted to the action of the strongest nitrating agents." The explanation of this statement is probably as follows. Noelting and Thesmar further nitrated 4-nitro-*o*-xylene, melting at 29—30°, and obtained two dinitroxylenes, melting respectively at 115—116° and 75—76°. The present authors arrived at the same results on repeating these experiments, except that they have not, so far, been able to raise the melting point of the latter substance above 71°. There are therefore a dinitro- and a trinitro-*o*-xylene, melting at 71°, and also a dinitro- and a trinitro-*o*-xylene melting at 115°. When Noelting and Thesmar submitted 4-nitro-*o*-xylene to the action of a nitrating mixture above a temperature of 100°, they doubtless obtained the two trinitro-derivatives melting at the same temperatures as their dinitro-compounds. The mixed melting-point method, however, shows the substances to be quite distinct; the dinitro- and trinitro-derivatives, melting at 71°, when mixed in equal quantity, melt at 45—50°, becoming quite clear at 63°; and the dinitro- and trinitro-derivatives, melting at 115°, when mixed, melt at 82—83° and become quite clear at 86°.

During the course of these experiments, a third dinitro-*o*-xylene, melting at 82°, has been isolated, and another substance, melting at 115°, which is not a nitroxylene, but a nitro-derivative of some condensed benzene ring derivative.

The authors are continuing the experiments, more particularly in the direction of the orientation of these hitherto unknown nitro-*o*-xylenes.

*46. "Substituted dihydrobenzenes. Part II. 1 : 1-Dimethyl-$\Delta^{2:4}$-dihydrobenzene and 1 : 1-dimethyl-$\Delta^{2:5}$-dihydrobenzene. By Arthur William Crossley and Nora Renouf.

Dimethyldihydrobenzene has been prepared by the elimination of two molecules of hydrogen bromide from 3 : 5-dibromo-1 : 1-dimethylhexahydrobenzene, and the resulting hydrocarbon has been



proved to consist of a mixture, in approximately equal parts, of 1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene (II) and 1 : 1-dimethyl-$\Delta^{2:5}$-dihydrobenzene (I). A detailed study of the properties of these substances leads to the conclusion that the 1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene described by Crossley and Le Sueur (Trans., 1902, **81**, 821) has the constitution ascribed to it, despite the adverse criticisms of Harries and Antoni (*Annalen*, 1903, **328**, 88); but it contains traces of some oxygenated substance, probably a methoxy-derivative.

*47. "The viscosity of aqueous pyridine solutions." By Albert Ernest Dunstan and Ferdinand Bernard Theodore Thole.

In view of the criticism to which their former work (Trans., 1907, **91**, 1718) has been subjected (Proc., 1908, **24**, 22), the authors have repeated their experiments on the viscosity of aqueous pyridine solutions, and find that the same discontinuities occur in the curve as were previously observed.

DISCUSSION.

Mr. HARTLEY said that he understood Mr. Dunstan to use the word "discontinuity" to denote a point where two supposed sections of a curve pass imperceptibly into one another, but, as under these conditions the curve is continuous, he thought the use of the term "discontinuity" was very misleading. The only evidence for the existence of the secondary irregularities which Messrs. Dunstan and Thole had endeavoured to prove depended on discontinuities in lines drawn through series of experimental points without making any allowance for experimental error. Such a method of argument was only allowable if around each point a circle was described of radius equal to the probable experimental error. If this were done in the case of the physical properties of mixtures of pyridine and water, he thought that a smooth curve could be drawn through the series of circles so obtained, as had been found by Thomas, Applebey, and himself.

Mr. DUNSTAN agreed with Mr. Hartley as to the difficulty of expressing the change of curvature in a simple way, and thought that perhaps the term "discontinuity" was the simplest in the light of his explanation of the curves. With reference to Mr. Hartley's system of plotting, he was quite in agreement with it, having, as a matter of fact, taken similar precaution in allowing for experimental error.

*48. "The action of thionyl chloride on the methylene ethers of catechol derivatives. II. Piperonyloin, piperil, and hydropiperoin." By George Barger and Arthur James Ewins.

By heating the methylene ethers, mentioned in the title, with thionyl chloride to 180—200°, cyclic *dicarbonates* result, which in all cases contain chlorine. By elimination of chlorine from the substance derived from piperonyloin and from piperil, the *dicarbonate* of *tetrahydroxybenzil* and *tetrahydroxybenzil*,

$$(OH)_2C_6H_3{\cdot}CO{\cdot}CO{\cdot}C_6H_3(OH)_2,$$

m. p. 237°, was obtained.

A number of other derivatives were described.

49. "Traces of a new tin-group element in thorianite."

By Clare de Brereton Evans.

In the course of an examination of some residues of 5 cwt. of thorianite belonging to Sir William Ramsay, traces of a supposed new element were discovered associated with the sulphides of the tin group.

The dark brown sulphide was separated with arsenious sulphide, which it resembles in being insoluble in hydrochloric acid, and readily soluble in ammonium carbonate solution, to which it gives a characteristic deep brown colour. In addition to these reactions, it dissolves readily in water, forming a deep brown solution; it is scarcely attacked by a mixture of hydrochloric acid and potassium chlorate, but dissolves in nitric acid, forming, on evaporation at 100°, a golden-red syrup, which leaves behind a hygroscopic, brown oxide at

120—130°. A grey metal was obtained by reduction in hydrogen, but the quantity was too small to allow of its equivalent being determined.

Incidentally, proof was obtained of the presence in thorianite of arsenic, mercury, bismuth, molybdenum, and selenium, in addition to those elements already discovered in the mineral.

A new triple oxalate of thorium, uranium, and ammonium was described; it appears to have the composition

$$ThU_2 5(NH_4)_2(C_2O_4)_{10}.14H_2O.$$

50. "The sulphination of phenolic ethers and the influence of substituents." By Samuel Smiles and Robert Le Rossignol.

The authors have previously drawn the conclusion (Proc., 1906, **22**, 158; Trans., 1906, **89**, 696) that the sulphonium base derived from phenetole is produced in three stages at which the sulphinic acid, sulphoxide, and base are consecutively formed. The sulphinic acid, however, had not been observed in the products of the reaction, and thus the evidence was incomplete. The above view of the mechanism of the reaction has now been confirmed by the isolation of the sulphinic acid from substituted phenolic ethers. It is proposed to apply to the entire process the name "sulphination." The behaviour of benzene, toluene, and homologous phenolic ethers has been investigated, and it was shown that the products vary according to the position of the methoxyl and methyl groups. Generally speaking, the presence of a group in the ortho-position with respect to the entrant quadrivalent sulphur atom tends to prevent the formation of sulphonium base; on the other hand, this is favoured by groups of strong directing influence.

51. "The relation between unsaturation and optical activity. Part II. Alkaloid salts of corresponding saturated or unsaturated acids." By Thomas Percy Hilditch.

The study of the relative effects of saturated and unsaturated acids on an optically active base has been extended to alkaloid salts of β-phenylpropionic, cinnamic, phenylpropiolic, and succinic, maleic, fumaric, and acetylenedicarboxylic acids. Salts of brucine, coniine, codeine, and cinchonine have thus been examined polarimetrically in chloroform solution, and the results show very clearly that the change in optical rotatory power is influenced not only by the simple change of constitution associated with increasing unsaturation, but also by the structure of the base and the type of acid used. Thus, in general, the effect observed in the case of coniine salts differs from those observed with the derivatives of more complex bases, and appears to be of the same kind as that observed by Walden with the active amyl esters of the same series of acids. It is noticeable, however, that in all the instances now brought forward the change to an ethylenic linking is accompanied by an increase in optical effect.

52. "The wandering of bromine in the transformation of nitroaminobromobenzenes." By Kennedy Joseph Previté Orton and Constance Pearson.

2 : 6-Dibromo-1-nitroaminobenzene, when dissolved in aqueous, aqueous alcoholic, or acetic acid solutions of hydrochloric or sulphuric acids, yields not only 2 : 6-dibromo-4-nitroaniline, but also the isomeric 2 : 4-dibromo-6-nitroaniline, the nitro-group having partly migrated to the vacant para-position, and having partly displaced an atom of bromine from one of the ortho-positions.

The use of hydrobromic or nitric acid in the same solvents leads largely to the reduction of the nitroamine to the diazo-compound, but at the same time migration of the nitro-group and displacement of bromine occur.

In a comparison, the behaviour of other nitroamines when similarly treated was described.

53. "A new isomeride of vanillin occurring in the root of a species of Chlorocodon." (Preliminary note.) By Ernest Goulding and Russell George Pelly.

A sample of the root of a species of *Chlorocodon* (probably *C. Whiteii*) was forwarded for examination to the Imperial Institute from Uganda, where the plant is known by the native name of "Murundo." This root has a pleasant odour, intermediate between those of vanillin and piperonal, and is said to be chewed by the natives for sweetening the breath.

The powdered root, on distillation with steam, yields 0·5 per cent. of a crystalline *substance*, $C_7H_5O_2 \cdot OMe$, which separates from the distillate in thin, lustrous, colourless plates, having the characteristic odour of the root. It melts at 41—42° and boils at 257—258°, a pale brown coloration being developed. The substance is readily soluble in most organic solvents, and fairly so in hot, but only sparingly so in cold, water. An aqueous solution gives a red or purplish-brown coloration with ferric chloride, and, on warming a solution with ammoniacal silver nitrate, the latter undergoes reduction with the separation of silver. It dissolves freely in dilute alkali hydroxide, and is reprecipitated by acids. The aqueous solution does not give a precipitate with lead acetate.

The *oxime*, $OMe\cdot C_6H_3(OH)\cdot CH\colon N\cdot OH$, crystallises in large, thin, lustrous, transparent plates, melting at 138°; it is almost odourless, and readily soluble in hot water but sparingly so in cold.

The *phenylhydrazone*, $OMe\cdot C_6H_3(OH)\cdot CH\colon N\cdot NHPh$, crystallises from hot alcohol in pale yellow, lustrous plates, and melts at 137—138°.

The *sodium* derivative, $OMe\cdot C_6H_3(CHO)\cdot ONa$, obtained by the addition of alcoholic sodium hydroxide to an alcoholic solution of the substance, separates in small, almost colourless, lustrous plates, and dissolves readily in water to form a pale yellow solution which is strongly alkaline.

These results, together with the analytical data obtained, show that the odorous constituent of *Chlorocodon* root is a monomethyl ether of a dihydroxybenzaldehyde, $OMe\cdot C_6H_3(OH)\cdot CHO$, which is not identical with vanillin or any of its known isomerides.

Unfortunately, the amount of material available was so small that it has not been possible to carry out experiments with the object of ascertaining the relative positions of the hydroxy-, methoxy-, and aldehyde-groups, but the authors intend to continue the work in this direction as soon as a further supply of the root has been obtained.

54. "The volatile oil of the leaves of Ocimum viride." (Preliminary note). By Ernest Goulding and Russell George Pelly.

A consignment of the leaves of *Ocimum viride*, forwarded for examination to the Imperial Institute, from Sierra Leone, has been examined with the following results. On distillation with steam, the leaves yielded about 0·35 per cent. of an orange-yellow, volatile oil, which is very mobile, has an aromatic, thyme-like odour, a spicy, pungent taste, D_{15}^{15} 0·9115, $[\alpha]_D + 1°30'$ (approx.), and is soluble in all proportions in 90 per cent. alcohol.

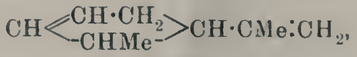
When distilled under the ordinary pressure, 100 c.c. of the oil yielded 25 c.c. boiling at 165—180°, with D_{15}^{15} 0·8614 and $[\alpha]_D + 0°33'$; 20 c.c. at 180—200°, with D_{15}^{15} 0·8804 and $[\alpha]_D + 1°40'$; 20 c.c. at 200—220°, with D_{15}^{15} 0·9164 and $[\alpha]_D + 2°38'$; 20 c.c. at 220—235°, with D_{15}^{15} 0·9548 and $[\alpha]_D + 3°38'$; and 10 c.c. at 235—250°, with D_{15}^{15} 0·9565 and $[\alpha]_D + 5°14'$.

The composition of the oil is approximately as follows: thymol, 32 per cent.; alcohols (calculated as $C_{10}H_{18}O$), 40 per cent.; esters (calculated as $C_{10}H_{17}\cdot OAc$), 2 per cent.; the remainder consists chiefly of a terpene (or possibly a mixture of terpenes), $C_{10}H_{16}$, which is a mobile, highly refractive liquid of pleasant, lemon-like odour, boiling at 160—166°, and having D_{15}^{15} 0·8456 and $[\alpha]_D + 0°10'$.

The authors intend to make a more complete examination of the oil as soon as a larger supply of material has been received.

55. "Experiments on the synthesis of the terpenes. Part XII. Synthesis of terpins, terpineols, and terpenes derived from the methyl*iso*propyl*cyclo*pentanes, $Me\cdot C_5H_8\cdot CHMe_2$." By Walter Norman Haworth and William Henry Perkin, jun.

An account was given of the synthesis of terpenes, such as



$$\mathrm{CH}\Big<\begin{matrix}\mathrm{CH\cdot CH_2}\\ \mathrm{CHMe}\end{matrix}\Big>\mathrm{CH\cdot CMe{:}CH_2},$$

which are analogously constituted to dipentene, but contain a *cyclo*pentene in the place of the *cyclo*hexene ring of the latter. The corresponding five-ring terpineols and terpins were also described.

56. "The initial change of the radium emanation." By Nevil Vincent Sidgwick and Henry Thomas Tizard.

In their paper on this subject, Cameron and Ramsay (*Trans.*, 1907, **91**, 1266) have shown that, after the removal of the hydrogen and oxygen, the radium emanation diminishes rapidly (in about an hour and a-half) to one-half of its initial volume. Hence it follows that the emanation (or a constituent) polymerises; the possibility of the simultaneous formation of helium or of a solid they consider they have disproved.

By measuring the rate of change, they show that the reaction is unimolecular, that is, the rate is proportional only to the amount of changing substance. They assume that two molecules of the original emanation Em_1 polymerise to one molecule of Em_2, and they say (p. 1280) "This involves an exponential curve, and that has been realised." But their exponential curve implies a unimolecular reaction, and a polymerisation cannot in the nature of things be unimolecular, since it necessarily involves the combination of two or more molecules. The reaction:

$$2Em_1 = Em_2$$

must be bimolecular, and, in general, any polymerisation must be a reaction of the n^{th} order, where n is the number of molecules that combine.

Hence the change they are measuring cannot be the polymerisation, and, as it is unimolecular, must be of the form:

$$\mathrm{Em}_1 = \mathrm{Em}',$$

and the polymerisation which obviously occurs must follow this change and must be rapid. We therefore have:

$$(1)\ \mathrm{Em}_1 = \mathrm{Em}' \ \text{(Slow : unimolecular)}$$

$$(2)\ n\mathrm{Em}' = \mathrm{Em}_2 \ \text{(Quick : } n\text{-molecular).}$$

Cameron and Ramsay assume that $n=2$: that two molecules of Em_1 give one of the final product. But this is not a necessary result of their equation, for, if the first reaction is unimolecular, we get:

$$-\frac{dV'_t}{dt} = kV't,$$

where V'_t is the amount af the changing substance Em_1 (or its volume reduced to standard pressure) at the time t from the true beginning of the reaction, the observed volume of gas being V_t. Now if n molecules of the first product (Em′) polymerise to one molecule of Em_2, the amount of Em_2 present at time t is obviously:

$$(V_o - V_t)\frac{1}{n-1},$$

where V_o is the total volume of gas at the beginning.

Therefore $$V'_t = V_t - (V_o - V_t)\frac{1}{n-1}$$

$$= \frac{nV_t - V_o}{n-1}$$

$$= \frac{n(V_t - V_\infty)}{n-1},$$

since V_∞, the final volume, $= V_o/n$.

Hence $$-\frac{dV'_t}{dt} = \frac{n}{n-1} \cdot \frac{dV_t}{dt} = kV'$$

$$= \frac{n}{n-1} \cdot k \cdot (V_t - V_\infty).$$

Therefore $$-\frac{dV_t}{dt} = k\cdot(V_t - V_\infty).$$

Integrating this, under the condition that when $t=0$, $V_t = V_o$, we obtain $$\log\frac{V_o - V_\infty}{V_t - V_\infty} = kt,$$

which is the expression that Cameron and Ramsay have shown to agree with the experimental results. It is obvious that it is equally compatible with any value of n.

Their reason for assuming that $n=2$ is that during the time of observation the volume of the gas diminishes to about a half; and they suppose that the time when the first observation is made is the actual beginning of the change, and that the gas then wholly consists of Em_1. It is, however, difficult to see how the reaction cannot have begun earlier than this. The emanation gradually accumulates in and over the solution of the radium salt for several days; it is then transferred to the explosion-burette, exploded, the emanation and the residual hydrogen passed over phosphoric oxide and cooled with liquid air, the hydrogen pumped off, and the emanation allowed to evaporate and passed into the capillary. Mr. Cameron informs us that the time taken in the purification is less than an hour, and the time elapsing between the evaporation of the emanation and the first measurement is less than a quarter of an hour. It seems scarcely possible that the change of Em_1 to Em', which, as it is unimolecular, is not affected by the dilution, should not take place during these operations, and yet when they are finished should begin with a velocity which takes it to half completion in about nine minutes. A more probable hypothesis is that the change has already proceeded some way before the observations begin, and that the actual number of molecules of Em_1 which go to form one molecule of Em_2 is greater than 2. Even if the reaction only begins when the liquid air has been removed, and the gas has assumed the temperature of the room, something like half the initial volume of Em_1 must have changed before the first measurement is made. On the other hand, the change cannot have continued during the whole time that the emanation has been accumulating, for, if we reckon the time backwards, the volume must increase a thousandfold every ninety minutes. It would therefore appear that for some reason the reaction does not begin until the liquid air is removed; before this point, the Em_1 must have been in a different chemical state. But as soon as the emanation has evaporated, it must begin to change at once, and, as it is not measured for nearly ten minutes after this, the volume of Em_1 at the first measurement cannot be much more than half the true initial volume, the period of half decay being about nine minutes. Hence the final volume is at most one-third of the initial, and n cannot be less than 3.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Dyer, *Bernard.* Fertilisers and feeding stuffs. Their properties and uses. With the full text of the Fertilisers and Feeding Stuffs Act, 1906, the regulations and forms of the Board of Agriculture, and notes on the Act by *A. J.* **David.** 5th edition. pp. viii + 150. London 1908. (*Recd.* 22/2/08.) From the Author.

Geological Society of London. The history of the Geological Society of London. By *Horace B.* **Woodward.** pp. xx + 336. ill. London 1907. (*Recd.* 20/2/08.) From the Society.

Glasgow, University of. Register of Members of the General Council . . . for the year commencing 1st January, 1908. pp. 163. Glasgow 1907. (*Recd.* 26/2/08.) From the University.

Menschutkin, *Boris N.* Life and work of N. A. Menschutkin. pp. viii + 376. ill. 1908. [In Russian.] (*Recd.* 11/1/08.) From the Author.

Rawson, *Christopher.* Report on the cultivation and manufacture of Indigo. (*For the Behar Indigo Planters' Association, Limited.*) 2nd edition. pp. 97. Calcutta 1907. (*Recd.* 25/2/08.) From the Author.

Society of Public Analysts. General index to "**The Analyst.**" Vols. xxi—xxx., 1896—1905. Compiled by *J. Cuthbert* **Welch.** pp. 352. London 1906. (*Reference.*) From the Society.

II. *By Purchase.*

Arrhenius, *Svante.* Untersuchungen über die galvanische Leitfähigkeit der Elektrolyte. Translated by *Anna* **Hamburger** and edited by *Otto* **Sackur.** (Ostwald's *Klassiker*, No. 160.) pp. 153. ill. Leipzig 1907. (*Recd.* 27/2/08.)

Cohen, *Ernst.* Das Lachgas. Eine chemisch-kultur-historische Studie. pp. vi + 99. ill. Leipzig 1907. (*Recd.* 19/2/08.)

Francis, *Francis*, and **Fortescue-Brickdale,** *J. M.* The chemical basis of pharmacology. An introduction to pharmacodynamics based on the study of the carbon compounds. pp. xii + 372. London 1908. (*Recd.* 19/2/08.)

Fraunhofer, *Joseph.* Bestimmung des Brechungs- und Farbenzerstreuungs-Vermögens verschiedener Glasarten in bezug auf die Vervollkommnung achromatischer Fernröhre. Edited by *Arthur von* **Oettingen.** (Ostwald's *Klassiker*, No. 150.) pp. 36. ill. Leipzig 1905. (*Recd.* 27/2/08.)

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and Council, and other business, will be held on Thursday, March 26th, 1908, at five o'clock in the afternoon.

The President will deliver his address, entitled: "The Electron as an Element."

LOTHAR MEYER MEMORIAL.

The Council has decided to make a donation of £10 to the Lothar Meyer Memorial Fund.

Many old pupils and admirers of the author of "Die Modernem Theorien der Chemie" may be desirous of contributing to this Memorial, and the Treasurer will be glad to receive, at an early date, subscriptions from Fellows and others to the Fund.

Cheques, &c., should be made payable to Dr. Alexander Scott, crossed "Lothar Meyer Memorial Fund A/c.," and sent to the Treasurer, Chemical Society, Burlington House, W.

ERRATA.

1908. P. 48, line 13 from below, and p. 51, line 5 from top, *for* "**Francis**" *read* "**Frances.**"

At the next Ordinary Meeting on **Thursday**, March **19th**, 1908, at **8.30** p.m., the following papers will be communicated:

"The constitution of electronegative 'thiocyanates.'" By A. E. Dixon and J. Taylor.

"An improved form of pyknometer." By W. R. Bousfield.

"The quantitative conversion of aromatic hydrazines into diazonium salts." By F. D. Chattaway.

"The action of heat on α-hydroxycarboxylic acids. Part IV. Racemic $\alpha\alpha$-dihydroxyadipic acid and meso-$\alpha\alpha$-dihydroxyadipic acid." By H. R. Le Sueur.

"The spontaneous crystallisation of sodium sulphate solutions." By H. Hartley, B. M. Jones, and G. A. Hutchinson.

"Quantitative relations of salts of thallium, and its separation from silver." By J. F. Spencer and Miss M. Le Pla.

"Constitution of hydroxyazo-compounds. Action of diazomethane and of mercuric acetate." By C. Smith and A. D. Mitchell.

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Issued 30/3/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 339

Thursday, March 19th, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Messrs. W. R. Bousfield, M. J. A. Braun, J. A. Carpenter, T. P. Hilditch, O. Oberländer, A. W. Oke, and T. M. Tyson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Leonard Clifford Green, B.E., Wienholt St., Torwood, Brisbane.
William Hall, B.Sc., Inglewhite, Manchester Road, Bolton.
Hugo Stefan Kohn, Ph.D., 3a, Hythe Road, Willesden Junction.
Gerald Roche Lynch, 160, Holland Park Avenue, W.

The President announced that Professor W. Jackson Pope had expressed himself unwilling to accept nomination for Vice-Presidency.

Of the following papers, those marked * were read :—

***57. "A new form of pyknometer." By William Robert Bousfield.**

The author described a new form of pyknometer, intended for very accurate density determinations.

*58. “The action of heat on α-hydroxycarboxylic acids. Part IV. Racemic αα′-dihydroxyadipic acid and meso-αα′-dihydroxyadipic acid.” By Henry Rondel Le Sueur.

When αα′-dihydroxyadipic acid melting at 146° (compare *Proc.*, 1907, **23**, 196) is heated above its melting point, it loses water, and its dilactone (m. p. 134°) is formed as a crystalline sublimate. The acid has been resolved into its optical antipodes by fractional crystallisation of its cinchonidine salt. The *d*-acid melts at 157°, and has $[\alpha]_D^{16} + 3{\cdot}8°$; its *ammonium* salt is lævorotatory and has $[\alpha]_D^{11} - 21{\cdot}4°$.

When the αα′-dihydroxyadipic acid melting at 174° is heated at 180—190°, it loses water, forming a lactone-lactide. All attempts to resolve this acid have failed, and it must therefore be regarded as the meso- or internally compensated variety.

That the acid which admits of resolution into its optically active components readily forms a dilactone, whereas the meso-variety does not, is in complete agreement with the spacial formulæ of these substances. Characteristic derivatives of both acids have been prepared.

*59. “The spontaneous crystallisation of sodium sulphate solutions.” By Harold Hartley, Bernard Mouat Jones, and George Adrian Hutchinson.

The authors have examined the spontaneous crystallisation of sodium sulphate solutions, and have found that if the solutions are subjected to mechanical friction three of the four possible solid phases, namely, ice, $Na_2SO_4,7H_2O$ and Na_2SO_4, are produced spontaneously at definite temperatures. Supersolubility curves have been traced for these three phases which, in conjunction with the solubility curve, define the labile and metastable regions for the system. The spontaneous crystallisation of the fourth solid phase, $Na_2SO_4,10H_2O$, is of rare occurrence compared with that of $Na_2SO_4,7H_2O$, and seems to take place irregularly without any definite relation to the temperature and concentration of the solution.

*60. “Constitution of hydroxyazo-compounds. Action of diazomethane and of mercuric acetate.” By Clarence Smith [and, in part, Alec Duncan Mitchell].

Diazomethane reacts with *p*-hydroxyazo-compounds to form the methyl ethers obtained by the ordinary methods of alkylation.

Benzeneazo-*p*-cresol, *p*-chlorobenzeneazo-*p*-cresol, and *β*-benzeneazo-*α*-naphthol do not react with diazomethane.

The action of mercuric acetate in boiling aqueous-alcoholic solution on benzeneazophenol, 2 : 4 : 6-tribromobenzeneazophenol, benzeneazo-*o*-nitrophenol, benzeneazo-*oo′*-dibromophenol, benzeneazo-*p*-cresol, and benzeneazo-*o*-bromo-*p*-cresol has been examined, with the result that the number of mercuriacetate groups entering the molecule of the hydroxyazo-compound is equal to the number of unsubstituted positions in the ortho-position with respect to the oxygen atom. The substances obtained are yellow, red, or reddish-brown compounds, readily soluble only in acetic acid, and not melting below 300°, with the exception of benzeneazo-*p*-cresol mercuriacetate,

$$C_6H_5{\cdot}N_2{\cdot}C_7H_5(OH){\cdot}Hg{\cdot}CO_2{\cdot}CH_3,$$

which melts at 269—270° with decomposition, and is identical with the compound obtained by Dimroth (*Ber.*, 1902, **35**, 2864). The corresponding mercurichlorides and mercuribromides have been obtained from the mercuriacetates by means of sodium chloride or potassium bromide in alkaline or acetic acid solution.

DISCUSSION.

Mr. BALY wished to put in a plea for the spectroscopic evidence which so decidedly pointed to the fact that, of the hydroxyazo-compounds, the ortho were quinonehydrazones, whilst the para had the true hydroxyazo-structure. He emphasised the fact that where a possibility of tautomerism existed as in the case under discussion, chemical means failed to determine which of the two possible desmotropic forms a substance possessed. Mr. Tuck had shown that the quinonehydrazone form, on the one hand, and the hydroxyazo-form, on the other, each represented by compounds the structure of which was beyond cavil, exhibited two types of spectra which differed very greatly in the relative dilution at which the absorption bands appeared, and also in the shape of the bands themselves. Inasmuch as the parent hydroxyazo-compounds conformed to one or other of these types, so was their constitution in alcoholic solution established notwithstanding any chemical evidence to the contrary.

It appeared further from Dr. Smith's paper that a slightly different interpretation might be put upon his results. Dr. Smith had pointed out that, in the case of the para-hydroxyazo-compounds, both methyl sulphate and diazomethane introduce a methyl group into the hydroxyl group, thus proving the hydroxyazo-configuration. In the case of the ortho-compound, diazomethane had no action and methyl sulphate only acted at 100°, and then the compounds behaved as if they possessed the hydroxyazo-structure. Again, Dr. Smith had pointed out that his experiments with mercuric acetate were carried out at 85°, but he (the speaker) thought these results rather led one to believe that the para-hydroxyazo-compounds were true hydroxyazo-bodies, but that the ortho-isomerides were quinonehydrazones at the ordinary temperature, and at 100° they tended to favour the hydroxyazo-form. In other words, as the temperature rose the equilibrium between quinonehydrazone and hydroxyazo-forms was shifted towards the hydroxyazo-side, so that at 100° the compounds could react in this form.

Dr. Morgan said that, in 1889, Professor Meldola and he had found that benzeneazo-β-naphthol could be benzoylated and ethylated only with some difficulty, and that the products, when mildly reduced in the presence of acids, underwent the benzidine transformation to 4 : 4′-diaminophenylnaphthyl bases which still contained the benzoyl and ethyl groups attached to the phenolic oxygen. They drew from these results the conclusion that the acyl and alkyl derivatives of benzeneazo-β-naphthol were true azo-compounds and not β-naphthaquinonehydrazones. It was interesting to find that the authors held the view that the ortho-hydroxyazo-compounds were really azo- and not hydrazino-derivatives.

The presence of many other constituents, besides the azo-group, in the contiguous α-position greatly modified the properties of β-naphthol or β-naphthylamine, but it was scarcely possible in every instance to ascribe this effect to the existence of a quinonoid configuration.

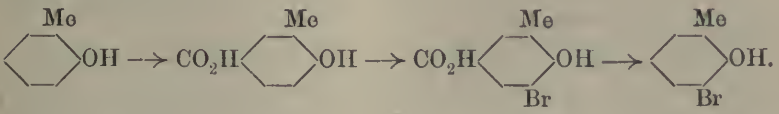
Dr. Hewitt drew attention to the fact that benzeneazo-*p*-cresol behaved as a phenol towards substituting agents even at the ordinary temperature. A cold solution of the substance in glacial acetic acid, containing excess of fused sodium acetate, brominated exclusively in the phenolic nucleus.

It should be remembered that spectrographic evidence, valuable though it was, ultimately depended on the determination of the constitution of typical substances by chemical methods.

Dr. Smith, in reply, expressed the opinion that the spectrometric evidence by no means conclusively proved the quinonehydrazone structure of *o*-hydroxyazo-compounds and of their acyl derivatives. Benzoquinonebenzoylphenylhydrazone, which was undoubtedly a quinonehydrazone, gave a totally different absorption spectrum from that of the isomeric benzoylbenzeneazophenol, which had the azo-structure, whilst benzoylbenzeneazo-*p*-cresol gave an absorption curve closely resembling that of benzeneazophenol. With regard to the point raised by Mr. Tuck, the reduction of β-benzeneazo-α-naphthyl acetate resulted first in the formation of the hydrazo-compound, then wandering of the acyl group from the oxygen to either of the nitrogen atoms took place, and, finally, fission occurred, yielding the four products, aniline and *N*-acetyl-2-amino-1-naphthol, acetanilide and 2-amino-1-naphthol.

*61. "Orthobromophenols and some bromonitrophenols."
By Philip Wilfred Robertson.

The method of direct bromination cannot be employed for the preparation of *o*-bromo-*o*-cresol or the corresponding *o*-bromoguaiacol. Accordingly, these compounds were obtained by an indirect method as is indicated in the following scheme, illustrating the changes in the case of *o*-cresol:



The constitution of the *o*-bromo-derivatives was confirmed by the fact that on nitration they yielded the same *o*-bromo-*p*-nitrophenols as are obtained from the *p*-nitrophenols by bromination.

o-*Bromo*-p-*nitro*-o-*cresol*, p-*bromo*-o-*nitro*-o-*cresol*, and o-*bromo*-p-*nitroguaiacol* form a red and a yellow series of *potassium* salts, being a confirmation of the recent work of Hantzsch (*Ber.*, 1907, **40**, 330).

Bromonitrothymol is anomalous, as only one isomeride (m. p. 109°) is obtained by the reactions: (1) nitration of *p*-bromothymol, (2) bromination of *o*-nitrothymol, (3) nitration of *o*-bromothymol, (4) bromination of *p*-nitrothymol; this isomeride must be o-*bromo*-p-*nitrothymol*, as it forms bromo-*p*-thymoquinone on oxidation.

62. "The constitution of thiocyanates containing an electronegative group." By Augustus Edward Dixon and John Taylor.

Examination of a number of acylthiocarbimides shows the contained ·NCS group to have the same refraction value as in hydrocarbon thiocarbimides; since this holds also for acetyl "thiocyanate" (Hawthorne, *Trans.*, 1906, **89**, 556), it seems probable that the ·NCS group is contained equally in acyl "thiocyanates" and acylthiocarbimides, true acyl thiocyanates being still unknown.

Moreover, the partial decomposition with formation of thiocyanic acid characteristic of "acyl thiocyanates" also takes place in the case of acylthiocarbimides, the latter undergoing this change with caustic alkalis or alkaline bases, but not with arylamines. The chemical differences between acyl thiocyanates and acylthiocarbimides are due, not to diversity of constitution, but to the variable resistance offered by the acyl radicle to its separation from the combined ·NCS group; when this is high, thiocarbimidic function preponderates, and when low, thiocyanic decomposition. Hence external circumstances, in so far as they affect that separation, may predominate in determining the direction of change.

Diphenylamine unites with acetyl, benzoyl, carboxymethyl- or carboxyethyl-thiocarbimide, forming an *a*-acyl-*bb*-diphenylthiocarbamide. a-*Acetyl*-bb-*diphenylthiocarbamide*, m. p. 141° (corr.), gives with alcoholic potash aa-*diphenylthiocarbamide*, m. p. 212°, and by distillation yields acetylthiocarbimide, identical with the compound produced from acetyl chloride and metallic thiocyanates; with acetic anhydride, *aa*-diphenylthiocarbamide regenerates *a*-acetyl-*bb*-diphenyl thiocarbamide.

a-*Benzoyl*-bb-*diphenylthiocarbamide*, a-*carboxymethyl*-bb-*diphenylthiocarbamide*, and a-*carboxyethyl*-bb-*diphenylthiocarbamide* melt at 135°, 128°, and 125° respectively; by lead or silver salts these trisubstitution compounds are desulphurised with difficulty, or not at all.

a-*Carboxymethyl*-ab-*diphenylthiocarbamide*, isomeric with the *bb*-diphenyl derivative, is obtained from methyl chlorocarbonate and thiocarbanilide; it melts at 106°, and, like *a*-carboxyethyl-*ab*-diphenylthiocarbamide, is desulphurised readily by alkaline salts of silver or lead.

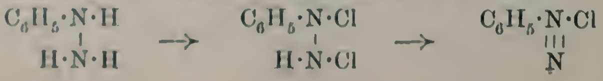
63. "The quantitative conversion of aromatic hydrazines into diazonium salts." By Frederick Daniel Chattaway.

All primary aromatic hydrazines can be quantitatively converted into the corresponding diazonium salts either by chlorine or by bromine.

If either halogen be allowed to act at a low temperature on the hydrazine dissolved in alcohol, the diazonium salt separates out in a pure state.

Unless, however, the solid salt is required, the operation can be most easily carried out by dissolving the hydrazine in glacial acetic acid, cooling the solution to about − 15° by the addition of crushed ice, and either passing in a rapid stream of chlorine or adding the calculated quantity of bromine dissolved in acetic acid and similarly cooled by ice.

The formation of the diazonium salt is without doubt effected by a substitution of two atoms of hydrogen in the hydrazino-group by halogen, followed by the elimination of halogen acid, thus:



$$\begin{array}{c} C_6H_5\cdot N\cdot H \\ | \\ H\cdot N\cdot H \end{array} \longrightarrow \begin{array}{c} C_6H_5\cdot N\cdot Cl \\ | \\ H\cdot N\cdot Cl \end{array} \longrightarrow \begin{array}{c} C_6H_5\cdot N\cdot Cl \\ ||| \\ N \end{array}$$

As in other cases where hydrogen attached to nitrogen is replaced by halogen, an additive product is probably first formed, in this instance by the addition of four halogen atoms, each nitrogen atom becoming quinquevalent, the elimination of halogen acid then gives rise to the diazonium salt, which being stable under the conditions of the experiment can be isolated.

64. "Quantitative separation of thallium from silver." By James Frederick Spencer and Margaret Le Pla.

A quantitative separation of the salts of silver and thallium is effected by treating the mixture with a stream of chlorine, whereby the thallium is oxidised to the very soluble thallic chloride and the silver is precipitated as silver chloride. After removing the latter, the solution is concentrated, and reduced by means of sulphur dioxide (either liquid or gaseous). The excess of sulphur dioxide is removed by boiling, and the thallium precipitated as thallous iodide, filtered, washed, and dried at 140°. The results are quantitative, and are obtained very quickly.

Thallous chloride was found to be more soluble in potassium carbonate than in water, for whereas water dissolves 3·86 grams per litre at 25°, a 5N-solution of potassium carbonate dissolves 21·84 grams per litre at the same temperature.

65. "Molecular volumes of the nitrites of silver, mercury, and the alkali metals." By Prafulla Chandra Rây.

The author finds that the molecular volumes of the nitrites of lithium, sodium, potassium, silver, and mercury are 63·44, 63·98, 88·88, 69·16, and 83·04 respectively.

66. "Lithium nitrite and its decomposition by heat." By Prafulla Chandra Rây.

Lithium nitrite is a mono-hydrated salt, and does not crystallise with half a molecule of water as stated by Lang.

In its general properties it resembles the nitrites of the other alkali metals.

67. "The existence in aqueous solutions of a univalent cadmium ion, a subvalent thallium ion, and a bivalent bismuth ion." By Henry George Denham.

The method of continuous circulation used by Denham and Allmand (*Trans.*, 1908, **93**, 424) to prove the existence of a univalent lead ion in aqueous solution has been applied to investigate the existence of similar ions of other metals.

A hot solution of cadmium sulphate was kept circulating over a column of granulated cadmium, and in thirty-six hours well-marked crystals began to appear, proving that the ionic reaction $Cd^{\cdot\cdot} + Cd \longrightarrow 2Cd^{\cdot}$ had taken place with absorption of heat, and had been reversed in the cold part of the apparatus.

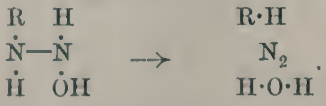
Granulated thallium, in contact with a solution of thallous sulphate, gave a similar crystalline deposit in three days, demonstrating the reaction $Tl^{\cdot} + Tl \longrightarrow Tl_2^{\cdot}$, and in the light of this experiment it is considered probable that the darkening of thallous haloid salts on exposure to sunlight is due to the formation of coloured sub-haloid salts, analogous to the case of silver.

Bismuth, heated in contact with a solution of the oxychloride in hydrochloric acid, soon gave unmistakable evidence of the production of the ion $Bi^{\cdot\cdot}$, but it is of interest that no evidence for such an ion was obtained in the case of arsenic or antimony. Nickel and nickel sulphate solution showed no signs of crystals, although in this case a suboxide Ni_2O has been described.

68. "Note on the oxidation of phenylhydrazine by Caro's acid."

By John Cannell Cain.

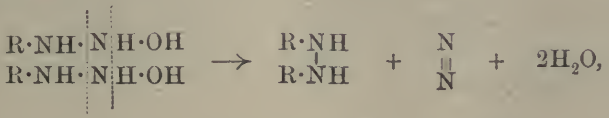
In explaining the mechanism of the oxidation of aromatic hydrazines by free oxygen and other oxidising agents, Chattaway (*Trans.*, 1907, **91**, 1323; 1908, **93**, 270) assumes the formation of an unstable hydroxyhydrazine which immediately loses water and nitrogen, thus:



$$\begin{array}{c} R\quad H \\ \dot{N}-\dot{N} \\ \dot{H}\quad \dot{O}H \end{array} \longrightarrow \begin{array}{c} R{\cdot}H \\ N_2 \\ H{\cdot}O{\cdot}H \end{array}.$$

The presence of such a hydroxyhydrazine was not observed by Chattaway, as the oxidation always proceeded with immediate evolution of nitrogen, but striking confirmation of this hypothesis is afforded when phenylhydrazine (1 mol.) is oxidised by Caro's acid (equivalent to 1 atom of oxygen). When ice-cold, neutral, aqueous solutions (saturated with ether) of these agents are mixed together, a greenish-yellow coloration is immediately produced; this persists for some seconds, when vigorous evolution of nitrogen begins, the greenish-yellow coloration gives place to a yellow turbidity, and benzene appears on the surface of the liquid. On extraction with ether, the only products are benzene and azobenzene, no diazo-compound being formed. The same phenomenon is observed if equimolecular amounts of phenylhydrazine and oxygen (as Caro's acid) are used, or if the solutions are rendered slightly alkaline or acid before mixing. It appears highly probable that the greenish-yellow coloration is due to the presence of a hydroxyhydrazine as postulated by Chattaway, and that this then undergoes disruption into benzene and azobenzene.

No explanation is given by Chattaway of the mechanism by which azo-compounds are formed in the reaction, but it seems probable that two molecules of the hydroxyhydrazine may decompose according to the scheme:



$$\begin{array}{l} R\cdot NH\cdot N \vdots H\cdot OH \\ R\cdot NH\cdot N \vdots H\cdot OH \end{array} \rightarrow \begin{array}{l} R\cdot NH \\ \quad | \\ R\cdot NH \end{array} + \begin{array}{c} N \\ \| \\ N \end{array} + 2H_2O,$$

giving rise (in the case of phenylhydrazine) to hydrazobenzene which would be immediately oxidised to azobenzene.

Confirmation of this is perhaps furnished by Chattaway's isolation, in one experiment using 100 grams of phenylhydrazine, of a very small amount of a white, crystalline solid melting at 125°. As this substance was not recrystallised, it appears likely that it was hydrazobenzene, which melts at 131° [Gattermann (*Practical Methods of Organic Chemistry*) gives 126°].

69. "Some reactions of keten." By **Frances Chick** and **Norman Thomas Mortimer Wilsmore.**

No better source for the preparation of keten by the "pyrogenic" method than acetic anhydride has been found. With this substance a yield of about 10 per cent. of fairly pure keten is readily obtained. Acetone is more easily split up, but the resulting keten is too impure for most purposes. Glacial acetic acid is not attacked by the hot wire.

All attempts to prepare glycollaldehyde by the action of keten on water were unsuccessful, only acetic acid being formed. The aldehyde reactions previously mentioned (*Trans.*, 1907, **91**, 1941) were found to be due to traces of formaldehyde in the crude keten. Carefully fractionated samples of keten, such as those used for analysis, did not give the aldehyde reactions. Similarly, with alcohol only ethyl acetate was formed.

Gaseous keten is slightly soluble at the ordinary temperature in benzene, chloroform, carbon tetrachloride, and ether, and very soluble in acetone and in acetic anhydride. Liquid keten is miscible without chemical reaction with most organic solvents which are liquid at its boiling point, including alcohol.

By the action of liquid hydrogen chloride on liquid keten at the ordinary temperature, acetyl chloride, boiling at 51—52°, was obtained. There was no sign of the presence of chloroaldehyde or of dichloroethyl acetate, but a small quantity of an oil with a terpene-like smell was obtained from the residue. In the same way with liquid hydrogen sulphide, thioacetic anhydride, boiling at 55—58°, was formed.

Keten does not react with oxamide, benzamide, nitrosoaniline, acetyl chloride, amyl nitrite, or ethyl iodide. Also, liquid keten does not react at the ordinary temperature with liquid cyanogen. It reacts slowly, however, with anhydrous hydrocyanic acid, but does not appear to form acetyl cyanide.

70. "Para- and meta-nitrosoacetanilide." By John Cannell Cain.

Para- and meta-nitrosoacetanilide have been prepared by oxidising the corresponding monoacetylphenylenediamine with Caro's acid.

p-*Nitrosoacetanilide* exists in two modifications: the unimolecular form is green, and melts at 176° with decomposition, whilst the bimolecular variety is colourless, and melts at 180—181° without decomposition.

This appears to be the first instance of both modifications of a nitroso-compound existing in the solid condition.

m-*Nitrosoacetanilide* also exists in two forms: the unimolecular modification, which was not isolated as it could not be obtained free from the bimolecular variety, remains as a green residue from its ethereal solution. This, on crystallisation from alcohol, furnishes the bimolecular form in pale, yellowish-brown needles melting at 111°.

71. "Labile isomerism among acyl-salicylamides and acyl-hydroxyamines." By Arthur Walsh Titherley.

A reply to Auwers' criticism (*Ber.*, 1907, **40**, 3506).

ADDITIONS TO THE LIBRARY.

By Purchase.

Grotthuss, *Theodor von.* Abhandlungen über Elektrizität und Licht. Edited by *R.* **Luther** and *Arthur von* **Oettingen.** (Ostwald's *Klassiker*, No. 152.) pp. 199. ill. Leipzig 1906. (*Recd.* 27/2/08.)

Herz, *W.* Physikalische Chemie als Grundlage der analytischen Chemie. (Die chemische Analyse, Vol. III.) pp. 114. Stuttgart 1907. (*Recd.* 19/2/08.)

Post, *Julius.* Chemisch-technische Analyse. Handbuch der analytischen Untersuchungen zur beaufsichtigung chemischer Betriebe. Edited by *Bernhard* **Neumann.** Vol. I, part 4. pp. 815 to 974. ill. Braunschweig 1908. (*Recd.* 30/1/08.)

Sella, *Quintino.* Abhandlungen zur Kristallographie. Edited by *F.* **Zambonini.** (Ostwald's *Klassiker*, No. 155.) pp. 44. Leipzig 1906. (*Recd.* 27/2/08.)

Sindall, *Robert Walter.* Paper technology. An elementary manual on the manufacture, physical qualities, and chemical constituents of paper and of paper-making fibres. pp. xv + 253. ill. London 1906. (*Recd.* 22/2/08.)

Thomsen, *Julius.* Thermochemistry. Translated from the Danish by *Katherine A.* **Burke.** pp. xv + 495. London 1908. (*Recd.* 15/2/08.)

LOTHAR MEYER MEMORIAL.

The Council has decided to make a donation of £10 to the Lothar Meyer Memorial Fund.

Many old pupils and admirers of the author of "Die Modernen Theorien der Chemie" may be desirous of contributing to this Memorial, and the Treasurer will be glad to receive, at an early date, subscriptions from Fellows and others to the Fund.

Cheques, &c., should be made payable to Dr. Alexander Scott, crossed "Lothar Meyer Memorial Fund A/c.," and sent to the Treasurer, Chemical Society, Burlington House, W.

At the next Ordinary Meeting, on **Thursday**, April 2nd, 1908, at **8.30** p.m., the following papers will be communicated:

"The condensation of epichlorohydrin with phenols." By D. R. Boyd and E. R. Marle.

"Rate of hydrolysis of chloroacetates, bromoacetates and α-chlorohydrin by water and by alkali, and the influence of neutral salts on the reaction velocities." (Preliminary note.) By G. Senter.

"A new general method of preparing diazonium bromides." By F. D. Chattaway.

"On the probable nature of the impurity found in the triphenylmethane spectrum." By W. N. Hartley.

"The absorption spectrum of triphenylmethane." By A. G. G. Leonard.

"The constituents of Cyprus origanum oil. Isolation of a new terpene (origanene)." By S. S. Pickles.

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Issued 29/4/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 340

Thursday, March 26th, 1908, Annual General Meeting, Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Dr. A. MCKENZIE and Dr. G. T. MORGAN were appointed Scrutators, and the ballot was opened for the election of Officers and Council for the ensuing year.

The PRESIDENT announced that communications from Professor W. J. Pope, Mr. John Allen, and Prof. Adrian J. Brown had been received, stating their unwillingness to accept nomination as Vice-President and as Ordinary Members of Council respectively.

The President presented the Report of the Council on the progress of the Society during the past twelve months, and the Treasurer gave a statement as to the Society's income and expenditure during the year 1907.

The adoption of the Report of the Council, together with the Balance Sheet and statements of Accounts for the year ended 31st December, 1907, was proposed by Professor A. LIVERSIDGE, seconded by Professor E. DIVERS, and carried unanimously.

A vote of thanks to the Auditors, which was proposed by Dr. ALEXANDER SCOTT, seconded by Mr. OTTO HEHNER, was acknowledged by Dr. H. FORSTER MORLEY.

REPORT OF THE COUNCIL.

As in recent years, the Council have the satisfaction of stating that the prosperity of the Society continues, both the number of papers read and the number of Fellows on the list showing a considerable increase.

On the 31st December, 1906, the number of Fellows was 2,860. During 1907, 137 Fellows were elected and 5 reinstated, making a gross total of 3,002. The Society has lost 30 Fellows by death; 30 have resigned; 1 election and 1 reinstatement have become void; 1 newly-elected Fellow has withdrawn, and the names of 43 Fellows have been removed from the list for non-payment of Annual Subscriptions.

The total number of Fellows, therefore, at the 31st December, 1907, was 2,896, showing an increase of 36 over the number for the previous year.

The names of the deceased Fellows, with the dates of their election, are:

A. C. Aitkin (1901).
T. Andrews (1870).
P. T. Austen (1877).
A. Bottle (1873).
W. Bowen (1903).
E. Chapman (1868).
E. D. Chester (1882).
J. Clark (1876).
George Davey (1893).
A. Dupré (1860).
J. Gale (1866).
Sir D. Gamble, Bart. (1851).
S. Hall (1876).
L. F. V. Harcourt (1863).
B. J. Harrington (1897).
J. Ince (1867).
F. Keeling (1883).
C. O'Sullivan (1876).
F. J. M. Page (1871).
A. C. Palmer (1906).
S. Parfitt (1906).
Sir W. H. Perkin (1856).
H. D. Perkins (1905).
B. C. Polkinghorne (1899).
W. Pritchard (1870).
R. R. Swann (1905).
J. F. Walker (1865).
R. Warington (1863).
H. A. Wetzel (1883).
H. E. Wright (1900).

The following Fellows have resigned:

A. Amos.
A. C. Benson.
T. H. Boardman.
J. Cameron.
J. Daniell.
T. Divine.
G. Dyson.
A. T. Eutroppe.
J. A. Fawcett.
G. Goldfinch.
W. F. Grace.
R. Grimwood.
W. B. Hards.
G. H. U. Harrow.
H. J. Hodges.
W. A. F. Lethbridge.
H. Martin.
H. G. F. Micklewright.
J. T. Nance.
D. Northall-Laurie.
A. N. Palmer.
E. W. Sawdon.
T. Steel.
S. D. Stennitt.
A. E. Tanner.
W. H. Templeman.
J. H. Wainwright.
J. W. Wells.
H. Wilson.
J. H. Wolfenden.

The number of those Fellows who were elected prior to 1860 has been still further diminished by the death of Sir David Gamble, Bart., who was elected on March 17th, 1851, and Sir William H. Perkin, who was elected on December 15th, 1856.

The number of Honorary and Foreign Members at the close of 1906 was 33. No elections have taken place during 1907, but the Society has to mourn the loss of Professor Marcellin Berthelot, elected March 1st, 1860, deceased March 18th; Professor Dr. Dmitri Ivanovitsch Mendeléeff, elected February 1st, 1883, deceased February 2nd; Professor Dr. Nicolai Menschutkin, elected January 20th, 1898, deceased February 5th; and Professor Henri Moissan, elected January 20th, 1898, deceased February 20th. The number of Honorary and Foreign Members, therefore, at the 31st December, 1907, was 29.

During the year 1907, 268 scientific communications have been made to the Society, 203 of which have been published already in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of Transactions for 1907 contains 2,089 pages, of which 2,021 are occupied by 205 memoirs, the remaining 68 pages being devoted to the Faraday Lecture, the Obituary Notices, the Report of the Annual General Meeting, and the Presidential Address; the volume for the preceding year contains 186 memoirs, which occupy 1,890 pages.

The Journal for 1907 contains also 4,686 abstracts of papers published mainly in foreign journals, which extend to 2,100 pages, whilst the abstracts for 1906 numbered 4,541, and occupied 1,912 pages.

The abstracts for 1907 may be classified as follows:

	Pages.	No. of Abstracts.
PART I.		
Organic Chemistry	1,104	1,831
PART II.		
General and Physical Chemistry		725
Inorganic Chemistry		622
Mineralogical Chemistry		117
Physiological Chemistry		545
Chemistry of Vegetable Physiology and Agriculture		241
Analytical Chemistry		602
	996	2,855
Total in Parts I. and II.	2,100	4,686

In the hope of diminishing the confusion which had arisen in the nomenclature of the proteins, consideration of the subject was undertaken by the Publication Committee, in conjunction with representatives of the Physiological Society; the joint committee concluded their deliberations early in 1907, and their recommendations appear in the Proceedings for that year.

Recognising the importance, from a public standpoint, of the Presidential Address delivered by Professor Meldola, F.R.S., in March, 1907, the Council have felt it desirable that his remarks on that occasion should attract the attention of a wider circle than is reached by the Society's Transactions; accordingly 5,000 copies of the address have been circulated among the members of various public bodies, including both Houses of Parliament, and the Council hope that this unusual step will have the effect of bringing the subject of Professor Meldola's discourse into suitable prominence.

During the past year, the Society has had to mourn the loss of Sir William Perkin, which took place on July 14th, 1907, just twelve months after the International Celebration which marked the Fiftieth Anniversary of the Foundation of the Coal Tar Colour Industry. This is not the place in which to deal with the splendid achievements of the late Past President, or the qualities which endeared him to the Fellows, who will remember with melancholy satisfaction that he lived to participate in the widely-supported public appreciation of the preceding year, and in the subsequent commemoration celebrated in the United States. The marble bust of Sir William Perkin has now been placed in the meeting room, and a large photograph of the portrait painted by Mr. A. S. Cope, A.R.A., is also the property of the Society, having been presented by Sir William a few months before his death.

In view of the losses incurred during recent years through the death of several Honorary and Foreign Members, thereby reducing the number of survivors to 29, the Council recommended for election the following distinguished chemists: Professor A. E. J. Gautier, Professor Albin Haller, Professor J. W. Hittorf, Professor J. A. Le Bel, Professor H. L. Le Chatelier, Professor T. W. Richards, and Professor Otto Wallach. This recommendation was duly ratified by the Society at the meeting on Thursday, February 6th, 1908.

An agreeable feature of the past year has been the Jubilee Celebration of the Société Chimique de France, and on that occasion an address of congratulation was presented by Sir William Ramsay, F.R.S., on behalf of the Society, which was represented also by Professor H. E. Armstrong, F.R.S., and Dr. Horace Brown, F.R.S.; a commemorative medal has been received from the French institution, and added to the Society's collection. A somewhat similar event took place in September, when the Geological Society celebrated their Centenary, the President being again delegated to offer the felicitations of the Chemical Society. A copy of the recently compiled History of the Geological Society has been since presented to the Library.

Professor J. Bretland Farmer, F.R.S., accepted the invitation of the Council to deliver a discourse before the Society, and his lecture, entitled "Some Borderline Problems in Botany," was greatly appreciated by the Fellows.

Late in 1906, Geheimrat Professor Emil Fischer, F.R.S., an Honorary and Foreign Member since 1892, was nominated Faraday Lecturer, and gave his address, in German, on October 18th, 1907, in the theatre of the Royal Institution, kindly lent by the managers for the occasion; at the termination of the lecture, entitled "Synthetical Chemistry in its Relation to Biology," the Faraday Medal was presented to Professor Fischer by the President.

In common with all corporate bodies engaged in scientific pursuits, the Chemical Society has keenly deplored the death of Lord Kelvin, who, although not on the roll of Fellows, had been the guest of the Society on many occasions. At the request of the Council, the President transmitted to Lady Kelvin a resolution of sympathy, and the Society was represented at the funeral ceremony in Westminster Abbey.

Professor W. Wislicenus, of Tübingen, having initiated a memorial to the late Professor Lothar Meyer, the Treasurer was authorised to contribute from the funds of the Society, and the Council venture to hope that the memorial may be supported by individual Fellows.

The ventilation of the meeting room and council chamber has occupied the attention of the House Committee, who have recommended the installation of electric fans; since their report was received and adopted by the Council, a Fellow, who desires to remain anonymous, has most kindly undertaken to defray the cost of this highly necessary improvement.

In addition to an engraving of Daniell and Faraday, for which the Society is indebted to Professor Meldola, F.R.S., numerous articles of historical interest and value have come into the possession of the Society in virtue of a bequest by the late Professor Warington.

The number of books borrowed from the Library during 1907 was 1,317, as against 1,126 in the previous year. The additions to the Library comprise 138 books, of which 79 were presented, 401 volumes of periodicals (representing 243 journals), and 40 pamphlets, as against 121 books, 385 volumes of periodicals (representing 229 journals), and 32 pamphlets last year.

The experiment of opening the Library during Thursday evenings other than those on which the Society meets has been discontinued, so few Fellows having used the Library on those occasions.

In May, 1907, a special leaflet was issued with the Journal indicating the parts required to complete certain sets of periodicals in the Library, in the hope that Fellows happening to possess copies of the desired numbers would present them to the Society. In response to that circular, donations were received from numerous Fellows, and this favourable response has encouraged the Council to hope that further contributions of a similar character may be added to the Library.

As was announced at the last Annual Meeting, the Society received from the Worshipful Company of Goldsmiths a munificent donation of £1,000 for the Research Fund. This fund has been still further increased by the handsome sum of £2,704 3*s.* 8*d.*, which was handed over to the Treasurer in July by the Perkin Memorial Fund Committee. These two sums, as now invested, have augmented the annual income of the Research Fund by £126 5*s.*, and will enable the Research Fund Committee in the present year to recommend the Council to make grants to the amount of £340 to £350. Of this sum, about £34 is more or less especially to be devoted to the encouragement of research in inorganic and metallurgical chemistry, and about £92 for investigations relating to problems connected with the coal-tar and allied industries.

In spite of several items of a somewhat exceptional nature, the Treasurer is glad to be able to report that he has a substantial surplus to carry forward as the result of the year's finance. The income of the Society from all sources for 1907 is £7,260 4*s.* 10*d.*, as against £7,121 8*s.* 11*d.* in 1906, and the expenditure is £6,750 8*s.* 5*d.*, instead of £6,379 15*s.* 9d., so that, whilst our expenditure has increased by £370 12*s.* 8*d.*, our income has only grown by £138 15*s.* 11*d.* This still leaves a surplus of £509 16*s.* 5*d.* on the year's working.

The increase in income may be put down almost entirely to the increase in Annual Subscriptions, for the increase of £100 in the Life Compositions is more than neutralised by the drop of £104 in Admission Fees.

The *Journal* and *Annual Reports* have cost respectively £182 19*s.* 8*d.* and £24 8*s.* 5*d.* more than last year, but a saving of £23 18*s.* has been effected on the *Proceedings* and the *List of Fellows.* The reprinting of certain numbers of the *Proceedings* which were "out of print" has put it within the power of Fellows to complete their sets of *Proceedings*, and the increase in the sale has already more than repaid the cost of the reprints.

A certain amount of redecoration beyond the annual cleaning, the balance of the Dinner account, and the printing and distribution of

5,000 copies of last year's Presidential Address are the chief items which have raised the "administrative expenses" so much above those of last year.

In July the Treasurer was able to purchase £1,200 North British Railway 3 per cent. Debenture Stock; a glance at the balance sheet will show that the value of the invested capital of the Society was on December 31st, 1907, £18,362 9*s*. 9*d*., and that of the Research Fund, £10,016 11*s*. 10*d*.

A vote of thanks to the Treasurer, Secretaries, Foreign Secretary, and Council for their services during the past year was proposed by Dr. FRANK CLOWES, seconded by Dr. W. E. ADENEY, and unanimously adopted. Professor J. EMERSON REYNOLDS responded.

The President then delivered his address entitled "The Electron as an Element."

Professor RAPHAEL MELDOLA proposed a vote of thanks to the President for his address and for his services in the Chair during the past year, coupled with the request that he would allow the address to be printed in the *Transactions* of the Society. Dr. RUDOLPH MESSEL seconded the motion, which was put to the Meeting and carried with acclamation.

The Report of the Scrutators was presented to the President, who declared the following to have been elected as Officers and Council for the ensuing year:

President: Sir William Ramsay, K.C.B., F.R.S.

Vice-Presidents who have filled the Office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir William Crookes, D.Sc., F.R.S.; Sir James Dewar, M.A., LL.D., F.R.S.; A. G. Vernon Harcourt, M.A., D.C.L., F.R.S.; Raphael Meldola, F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir Henry E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents: J. Campbell Brown, D.Sc., LL.D.; J. J. Dobbie, M.A., D.Sc., F.R.S.; F. Stanley Kipping, D.Sc., Ph.D., F.R.S.; Rudolph Messel, Ph.D.; Sir Alexander Pedler, C.I.E., F.R.S.; W. H. Perkin, Ph.D., F.R.S.

Treasurer: Alexander Scott, M.A., D.Sc., F.R.S.

Secretaries: M. O. Forster, D.Sc., Ph.D., F.R.S.; A. W. Crossley, D.Sc., Ph.D., F.R.S.

Foreign Secretary: Horace T. Brown, LL.D., F.R.S.

Ordinary Members of Council: Julian L. Baker; George T. Beilby, F.R.S.; Alfred C. Chapman; Julius B. Cohen, Ph.D., B.Sc.; J. T. Hewitt, M.A., D.Sc., Ph.D.; W. R. E. Hodgkinson, Ph.D.; H. A. D. Jowett, D.Sc.; H. R. Le Sueur, D.Sc.; F. E. Matthews, Ph.D.; A. G. Perkin, F.R.S.; W. J. Sell, Sc.D., F.R.S.; John Wade, D.Sc.

Thursday, April 2nd, 1908, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. H. Bassett, jun., H. T. Clarke, and C. Dickinson were formally admitted Fellows of the Society.

It was announced that the Council had appointed the following Committees for 1908—1909:

Finance Committee: Messrs. E. G. Hooper, G. T. Moody, T. E. Thorpe, W. A. Tilden, and the Officers.

House Committee: Messrs. W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. M. Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

Library Committee: Messrs. E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. M. Thomson (*Chairman*), J. A. Voelcker, J. Wade, the Editor, and the Officers.

Publication Committee: Messrs. E. C. C. Baly, W. R. Dunstan, J. T. Hewitt, R. Meldola, G. T. Morgan, T. E. Thorpe, J. Wade, and the Officers.

Research Fund Committee: Messrs. G. T. Beilby, P. F. Frankland, A. D. Hall, G. Matthey, R. Meldola, R. Messel, W. H. Perkin, J. E. Reynolds, W. A. Tilden, Sir A. Pedler, and the Officers.

Certificates were read for the first time in favour of Messrs.:

Donald Francis Blyther, B.Sc., 77, Knights Road, Silvertown, E.
Henry Brougham Hutchinson, Ph.D., Ashby Villa, Devonshire Road, Harpenden.
Stanley Allen Warrington Okell, 27, King's Road, Ealing, W.
John Day Speed, Mill House, Enfield Lock, Middlesex.

Certificates have been authorised by the Council for presentation for ballot under Bye-Law I (3) in favour of Messrs. :

Cyril Arden Hinds, 724, Russell Street, Bristol, Tenn., U.S.A.
William Seelhorst, Eastern Smelting Co., Ltd., Penang, Straits Settlements.

Of the following papers, those marked * were read :—

*72. "Rate of hydrolysis of chloroacetates, bromoacetates, and α-chlorohydrin by water and by alkali, and the influence of neutral salts on the reaction velocities." (Preliminary note.)

By George Senter.

In a former paper (*Trans.*, 1907, **91**, 460), the results of an investigation of the rate of hydrolytic decomposition of certain chloroacetates by water and by alkali were given, and the effect of certain neutral salts on the rate of reaction was discussed. The rate of displacement of halogen by hydroxyl under different conditions has now been investigated for bromoacetic acid and sodium bromoacetate and for α-chlorohydrin, and the effect of certain neutral sodium salts on the reaction velocities has been examined.

Bromoacetic Acid.—The reaction represented by the equation $CH_2Br{\cdot}CO_2H + H_2O = HO{\cdot}CH_2{\cdot}CO_2H + HBr$ is unimolecular, and the value of $k = 1/t \log C_o/C_t$ is 0·0062 at 102°, as compared with $k = 0{\cdot}00048$ for chloroacetic acid under equivalent conditions. The reaction is slightly retarded by hydrogen bromide.

Sodium Bromoacetate. — The reaction $CH_2Br{\cdot}CO_2Na + H_2O = HO{\cdot}CH_2{\cdot}CO_2H + NaBr$ is unimolecular in dilute solution; the value of $k = 1/t \log C_o/C_t$ at 102° is 0·020. The hydrolysis of this salt by alkali, represented by the equation $CH_2Br{\cdot}CO_2Na + NaOH = HO{\cdot}CH_2{\cdot}CO_2Na + NaBr$, is bimolecular, and at 70·4° $k = \frac{1}{tC_o} \cdot \frac{C_t}{(C_o - C_t)}$ has the value 0·0314 when referred to a $N/10$ solution.

Effect of Temperature.—The average velocity quotients for a rise of temperature of 10° between the limits of temperature given are as follows. Chloroacetic acid and water (70—100°), 2·6 ; sodium chloroacetate and water (70—100°), 3·2 ; sodium chloroacetate and hydroxide (70—100°), 2·5 ; bromoacetic acid and water (70—100°), 2·4 ; sodium bromoacetate and water (70—100°), 2·9 ; sodium bromoacetate and hydroxide (30—70°), 2·75. The fact that the temperature-coefficients of the hydrolysis of sodium chloroacetate by water and by alkali are different, shows that the assumption often made, that the OH′ ions in the latter case act in a catalytic manner, is not justified, and supports the views on the mechanism of the reactions advanced in the previous paper (*loc. cit*).

a-Chlorohydrin.—The hydrolysis of α-chlorohydrin by water alone is extremely slow; the value of $k = 1/t \log C_0/C_t$ is 0·00010 at 101°. Hydrochloric acid retards the reaction slightly. In the presence of alkali, the change is extremely rapid; the value of k for the bimolecular reaction represented by the equation $HO{\cdot}CH_2{\cdot}CH(OH){\cdot}CH_2Cl + NaOH = HO{\cdot}CH_2{\cdot}CH(OH){\cdot}CH_2{\cdot}OH + NaCl$ is 0·052 at 0°, referred to a $N/10$ solution as unit.

Effect of Neutral Salts.—Neutral sodium salts slightly retard the hydrolysis of chloro- and bromo-acetates by water, they greatly accelerate the hydrolysis of these compounds by alkali, but have practically no effect on the rate of reaction between α-chlorohydrin and alkali. The accelerating effect of molar concentrations of different salts on 0·1 molar solutions of chloro- or bromo-acetates and alkali is represented in the table, the rate of the reaction in the absence of neutral salts being taken as unity.

Sodium Chloroacetate and Hydroxide at 70·4°:

Neutral salt ……	none	$NaNO_3$	$NaCl$	$NaClO_3$	$\frac{1}{2}Na_2SO_4$	$CH_3{\cdot}CO_2Na$	$H{\cdot}CO_2Na$
Ratio of velocities	1·0	1·55	1·55	1·55	1·55	1·58	3·3

Sodium Bromoacetate and Hydroxide at 70·4°:

Neutral salt .. … ….	none	$NaNO_3$	$NaBr$	$NaClO_3$	$H{\cdot}CO_2Na$
Ratio of velocities …	1·0	1·53	1·53	1·53	2·8

The effect of sodium nitrate on the reaction between sodium chloroacetate and hydroxide is of the same magnitude, within the limits of experimental error, at 55° and 101°.

The above results confirm the views on neutral salt action advanced in the previous paper, that the effect in question is mainly due to the action of the salt on the reacting substances, and appear to be incompatible with the hypothesis advocated from time to time by different observers, most recently by Armstrong and his co-workers (*Proc. Roy. Soc.*, 1907, **79**, *A*, 586), that neutral salt action is due to combination between salt and solvent, with consequent concentration of the solution.

DISCUSSION.

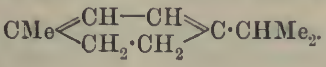
Mr. JEFFERS asked if Dr. Senter assumed that the pressure developed in the sealed tubes had no influence whatever on the velocity of hydrolysis. Pressure was known to have a large influence in the case of the hydrolysis of carbohydrates, and it seemed impossible to correlate the figure given for the velocity unless the pressure was known in all cases.

Dr. SENTER, in reply, pointed out that, according to the experiments of Röntgen (*Ann. Physik*, 1891, **45**, 98; compare also Rothmund, *Zeitsch. physikal. Chem.*, 1896, **20**, 170), the effect even of great changes of pressure on the rate of a reaction was very slight. In the case most fully investigated, a change of pressure from 1 to 500 atmospheres increased the rate of the reaction by 1 per cent. As in the present experiments the highest pressure in the sealed tubes was 2 atmospheres and the variations less than 1 atmosphere, it was obvious that the effect in question was quite negligible.

*73. "The constituents of Cyprus origanum oil. Isolation of a new terpene 'origanene.'" By Samuel Shrowder Pickles.

The essential oil yielded by the principal origanum plant of Cyprus has been examined and found to consist mainly of carvacrol (84 per cent.). There are also present (1) a hydrocarbon, $C_{10}H_{16}$, apparently a new terpene, for which the name *origanene* is proposed (2·5 per cent.); (2) cymene, which, together with associated terpenes (b. p. 170—180°), constitutes 8·5 per cent.; (3) terpene alcohols (3·5 per cent.), and (4) high boiling residue (1·3 per cent.), besides very small quantities of a second phenol which gives a purple coloration with ferric chloride, and a volatile acid, probably *iso*butyric acid.

The results of experiments on the constitution of the hydrocarbon "origanene" lead the author to conclude that the terpene is probably $\Delta^{1:3}$-p-*menthadiene*,



$$\mathrm{CMe}<\begin{matrix}\mathrm{CH-CH}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}>\mathrm{C\cdot CHMe_2}.$$

*74. "The displacement of halogen in *l*-phenylchloroacetic acid by hydroxy- and methoxy-groups. A contribution to the chemistry of the Walden inversion." By Alex. McKenzie and George William Clough.

The authors have resolved *r*-phenylchloroacetic acid into its optically active components by means of morphine in methyl-alcoholic solution.

The action of water on *l*-phenylchloroacetic acid, the action of water on sodium *l*-phenylchloroacetate, the action of aqueous sodium hydroxide on sodium *l*-phenylchloroacetate, the action of water on silver *l*-phenylchloroacetate, the action of silver carbonate on *l*-phenylchloroacetic acid, and the action of methyl-alcoholic sodium methoxide on *l*-phenylchloroacetic acid have been examined with reference to the Walden inversion.

Discussion.

Dr. Smith, referring to the fact that *d*-chlorosuccinic acid is converted by sodium hydroxide into *l*-malic acid and by silver oxide into *d*-malic acid, stated that Walden assumes that the inversion, which must have occurred during one of these changes, takes place in the second reaction. In view of Dr. Senter's result, that sodium chloroacetate and sodium hydroxide react ionically, the converse would seem to be more probable, for during the reaction between sodium hydroxide and *d*-chlorosuccinic acid, which by analogy is ionic, there would be a greater possibility for change of configuration to occur than in the reaction between *d*-chlorosuccinic acid and silver oxide, which would be a case of simple substitution.

Dr. McKenzie stated that Walden regarded the change

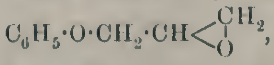
$$d\text{-}CO_2H{\cdot}CH_2{\cdot}CHCl{\cdot}CO_2H \longrightarrow l\text{-}CO_2H{\cdot}CH_2{\cdot}CH(OH){\cdot}CO_2H$$

by means of potassium hydroxide as, in all probability, optically normal, because the rotation of the malic acid formed is of the same sign as that of the malic acid from which *d*-chlorosuccinic acid is formed by the action of phosphorus pentachloride.

Fischer had pointed out (*Ber.*, 1907, **40**, 490) that the view that silver oxide acts abnormally, whilst potassium hydroxide acts normally, may appear somewhat strange to many chemists.

75. "The condensation of epichlorohydrin with phenols."

By David Runciman Boyd and Ernest Robert Marle.

The authors find the statements of Cohn and Plohn (*Ber.*, 1907, **40**, 2597) with regard to the products obtained by the action of epichlorohydrin on alkaline solutions of phenol and *p*-cresol to be incorrect. The crystalline compound (m. p. 81—82°) which is obtained from phenol and epichlorohydrin, and which is stated by Cohn and Plohn to be phenyl glycide ether,  $C_6H_5{\cdot}O{\cdot}CH_2{\cdot}CH{<}\begin{array}{l}CH_2\\ \,|\\ O\end{array}$, is really glyceryl diphenyl ether, $C_6H_5{\cdot}O{\cdot}CH_2{\cdot}CH(OH){\cdot}CH_2{\cdot}O{\cdot}C_6H_5$.

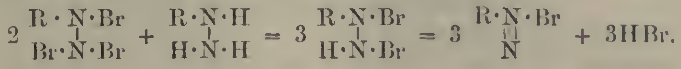
Phenyl glycide ether is an oil boiling at 133° under 23 mm. pressure.

Similarly, the crystalline compound (m. p. 88°) obtained from *p*-cresol and epichlorohydrin is the glyceryl di-*p*-tolyl ether, $C_7H_7{\cdot}O{\cdot}CH_2{\cdot}CH(OH){\cdot}CH_2{\cdot}O{\cdot}C_7H_7$, and not the *p*-tolyl glycide ether.

The authors have prepared *phenoxydichloropropane*, an oil boiling at 139—140° under 13 mm. pressure.

76. "A new general method of preparing diazonium bromides." By Frederick Daniel Chattaway.

Primary aromatic hydrazines react quantitatively with the diazonium perbromides producing diazonium bromides, thus:



$$2\,\begin{array}{c}\mathrm{R\cdot N\cdot Br}\\ |\\ \mathrm{Br\cdot N\cdot Br}\end{array} + \begin{array}{c}\mathrm{R\cdot N\cdot H}\\ |\\ \mathrm{H\cdot N\cdot H}\end{array} = 3\,\begin{array}{c}\mathrm{R\cdot N\cdot Br}\\ |\\ \mathrm{H\cdot N\cdot Br}\end{array} = 3\,\begin{array}{c}\mathrm{R\cdot N\cdot Br}\\ \|\\ \mathrm{N}\end{array} + 3HBr.$$

As the diazonium perbromides are so easily obtained in the solid state by adding bromine to aqueous solutions of diazonium salts, and as they can be kept in a dry atmosphere for a long time without alteration and are comparatively safe to handle, this reaction affords a very convenient method for preparing diazonium bromides in the solid state.

For this purpose, it is only necessary to suspend the finely-powdered perbromide in alcohol and, after cooling, to add the calculated quantity of the corresponding hydrazine also dissolved in alcohol and cooled. The solid diazonium bromide is at once formed, and, after adding an equal bulk of ether to complete the deposition, can be collected in a pure state.

The reaction is a general one, and takes place readily and quantitatively with all primary aromatic hydrazines and perbromides that have been studied.

77. "The absorption spectrum of triphenylmethane." By Alfred Godfrey Gordon Leonard.

In order to ascertain the cause of the difference between the absorption curve plotted by Hartley, in 1887, and that plotted by Baker, in 1907, the absorption spectrum of triphenylmethane was thoroughly re-examined.

All the specimens examined gave at first curves similar to that obtained in 1887, but, on purifying the samples by repeated recrystallisation from alcohol, the absorption curve became identical with that found by Baker. This curve is therefore the true absorption curve of triphenylmethane.

The difference is clearly shown to be caused by the presence of an impurity in the sample originally examined, and this impurity is always present when the triphenylmethane is prepared from benzene and chloroform by Friedel and Crafts' reaction (see following abstract).

78. "The nature of the impurity found in preparations of triphenylmethane." By Walter Noel Hartley.

The experiments of Mr. A. G. G. Leonard have shown conclusively that in the preparation of triphenylmethane there are always two substances obtained, even when the materials are of the greatest purity and free from moisture.

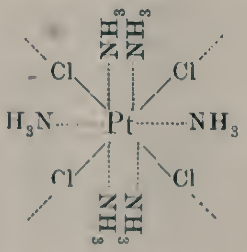
The second substance must be a hydrocarbon; it is yellow, and apparently it undergoes oxidation, becoming still brighter in colour. From these and other considerations, it appears to be identical with Gomberg's triphenylmethyl, and the final product, with triphenylmethyl peroxide.

79. "The constitution of co-ordinated compounds."

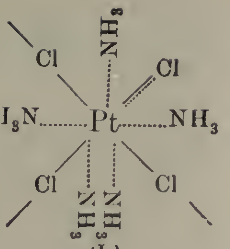
By Samuel Henry Clifford Briggs.

An attempt has been made to devise formulæ for co-ordinated compounds which will fulfil the requirements of the experimental results of Werner and his colleagues, and also give some idea of the manner in which the affinities of the atoms are disposed within the molecule.

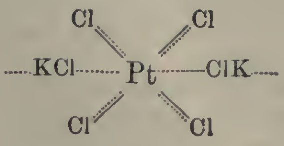
The existence of the two compounds $(Pt6NH_3)Cl_4$ and $(PtCl_6)K_2$, in which the platinum atom is the basis of a complex cation and anion respectively, suggests the view that the platinum atom has both positive and negative affinities (compare Berzelius, Abegg, and others). Assuming that every element has two kinds of affinity, $(Pt6NH_3)Cl_4$, may be written:



in which the saturation of the positive affinity of the platinum (situated at the centre of an octahedron) is expressed by a straight line, and the saturation of the negative affinity by a dotted line. On removing one molecule of ammonia and saturating the negative affinity of the platinum thus liberated by the free positive affinity of one of the chlorine atoms, we obtain (I). Similarly, $(PtCl_6)K_2$ is represented by (II).



(I.)



(II.)

These bonds are intended to represent the saturation of affinities only, and no assumptions are made with reference to the valencies of the atoms in question.

The formulæ were discussed from the point of view of the electrolytic dissociation of the compounds, and it is suggested that the non-ionisable chlorine atom in the compound $(Pt5NH_3Cl)Cl_3$ is the one which has both the negative and positive affinities saturated as expressed in the formula given above.

In the salts with a complex anion, these formulæ suggest the possibility of isomerism due to differences in the points of attachment of the positive atoms. The cases of isomerism in compounds with an anionic complex, which are referred to by Werner (*Neuere Anschauungen auf dem Gebiete der anorganischen Chemie*), can thus be satisfactorily explained.

80. "A combined stopcock and capillary connecting tube for gas burettes." By Arthur Edwin Hill.

The familiar method of connecting a Hempel burette to the absorption pipette by means of a short piece of thick-walled glass capillary tubing bent twice at right angles and two short pieces of thick rubber tube is very unsatisfactory, as it is liable to give inaccurate results, and requires a great deal of attention.

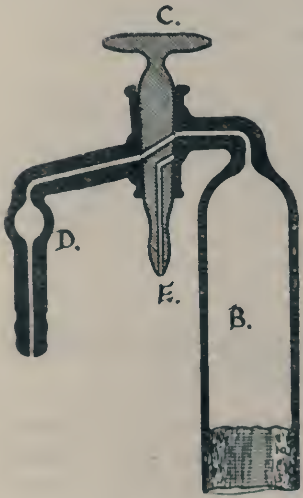
Before commencing an absorption, the air, entrapped in the capillary tubes and rubber connexions, should be expelled; as this operation is rather troublesome, it is often not properly effected. Again, when absorption is complete in the pipette and the gas is returned to the measuring burette, the absorbent should be allowed to flow back as far as the capillary tube at the top of the burette, but, since this adjustment has to be made when the thread of absorbent is out of sight behind the rubber connexion, some of it often finds its way into the burette before the pinchcock can be closed.

The combined stopcock and capillary connecting tube indicated in section in the figure is sealed to the top of the measuring burette *B*.

The three-way stopcock *C*, in addition to controlling the flow of gas from the burette, also affords a means of connecting the pipette with the outside air through the bottom outlet *E* when it is attached to the burette.

The burette is connected to the pipette by a short piece of thick rubber tube, which is slipped over and well wired to the end of the capillary connecting tube and to the capillary tube of the pipette.

To expel the air entrapped in the capillary tubes and rubber connexion, a piece of rubber tube is slipped over the bottom outlet *E* of the stopcock *C*, and the stopcock is turned to make connexion between the pipette and the outside air; the air is then sucked out through the tube, and the absorbent fills the vacant space. The stopcock is closed by giving it a half turn, so that the handle is in a plane at right angles to that of the connecting tube. In order to connect the burette with the pipette, the stopcock is given another half turn in the same direction as before. The barrel of the stopcock is pierced in a way which makes it impossible to connect the burette with the outside air through the bottom outlet *E*, a source of accidental error being thereby eliminated.



When absorption is complete and the gas is returned to the burette, the absorbent is allowed to flow back as far as the stopcock *C*, which is quickly closed to prevent it from flowing any further. The bulb *D* facilitates this adjustment by retarding the advance of the absorbent before it reaches the stopcock; it also prevents the drops of absorbent, which often lodge in the rubber connexion, from passing over with the gas into the burette.

Before the pipette is disconnected from the burette, the stopcock is turned back to the position which will connect the pipette with the outside air, and the thread of absorbent is allowed to flow back into the pipette. They are then disconnected, and those parts of the capillary connecting tube and stopcock which have been in contact with the absorbent can be washed with water and subsequently dried in a current of warm air without in any way affecting the contents of the burette.

Subsequent absorptions are effected by a similar procedure.

81. "The hydrolysis of amygdalin by emulsin. Part I." By Samuel James Manson Auld.

By means of specially devised apparatus, the hydrolysis of amygdalin by emulsin has been studied in detail by estimating the hydrocyanic acid produced during the reaction. It has been shown that Jorissen and Hairs' "emulsin" is really a mixture of two enzymes, namely, true emulsin and a maltase-like ferment. The effect of varying the concentration of amygdalin and emulsin has been investigated, as also the action of many inhibitants. Of particular importance is the fact elucidated that the activity of emulsin is intimately bound up with basic and acidic groups, as both acids and alkalis only render the ferment inactive and do not destroy it except in high concentrations. Contrary to the statements of Tammann, the decomposition of amygdalin by emulsin nearly approaches completion, as much as 97 per cent. of the available glucoside being decomposed as measured by the hydrocyanic acid formed. The end-point of the reaction has been found to be independent of the temperature, and the the temperature-coefficients of the action have been measured over a range of 45°.

82. "Complex nitrites containing potassium and lead. (Preliminary note.)" By Andrew Norman Meldrum.

The reaction between potassium nitrite and a lead salt (which may be the acetate, nitrate, chloride, bromide, or iodide) results in the production of complex compounds, which, in addition to potassium, lead, nitrosyl, and water, may contain one or more equivalents of the negative ion with which the lead was originally associated. The products vary in colour from bright yellow to orange, and they contain potassium and lead, as a rule, in the atomic ratio of 3 : 2.

In attempting to prepare the compound $K_2Pb(NO_2)_2(NO_3)_2,H_2O$, ($KO,NO_3,PbO,NO_5 + HO$, Hayes, *Quart. Journ. Chem. Soc.*, 1860, **13**, 335), the author finds that the product has always the composition, approximately, if not exactly, $K_2Pb(NO_2)_3NO_3,H_2O$.

Metallic lead is more easily attacked by solution of lead nitrate to which potassium nitrate has been added than by lead nitrate solution alone.

83. "The composition and formula of Wells' potassium lead periodide." By Andrew Norman Meldrum.

A potassium lead periodide has been described by Wells (*Amer. J. Sci.*, 1893, **46**, 190), who assigned to it the formula $K_3Pb_2I_8,4H_2O$, analogous to that of the perbromide, $K_3Pb_2Br_8,4H_2O$, described in the same paper. Actually, the analyses of six different preparations of the substance were in good agreement with one another, and with the formula $K_9Pb_4I_{19},10H_2O$. In arriving at the formula $K_3Pb_2I_8,4H_2O$, Wells made the assumption that the material analysed was "contaminated with about 16·5 per cent. of potassium iodide, and that an excess of water was present, possibly on account of the hygroscopic properties of that salt."

Potassium iodide (150 grams), lead iodide (4 grams), iodine (70 grams), and water (90 c.c.) were mixed, and the mixture was slowly heated to the boiling point and filtered to remove any undissolved lead iodide. After some time, crystals separated, which were collected, drained on a porous tile, and exposed to the air until the odour of iodine was very faint. The product consisted of shining *violet* prisms, not unlike potassium permanganate, and hardly corresponded with Wells' "brilliant *black*, prismatic crystals."

The substance was analysed by methods different from those used by Wells. The lead and potassium were determined together as the sulphates, and the lead separately as chromate. Thiosulphate solution was used to determine (1) the total iodine (after addition of sulphuric acid and ferric alum, with subsequent distillation), and (2) the "extra" iodine. Water and "extra" iodine were determined together as loss on heating at 100°.

Found: mixed sulphates = 53·14, 52·97; Pb = 21·71, 21·67; total iodine = 64·19; "extra" iodine = 6·76, 6·81; loss at 100° = 11·33, 11·04.

$K_9Pb_4I_{19}.10H_2O$ requires mixed sulphates = 52·97; Pb = 21·95; total iodine = 63·96; "extra" iodine = 6·74; loss at 100° = 11·52 per cent.

Potassium iodide, if present in a mixture to the extent of 16·5 per cent., the assumption which Wells makes, would surely be visible to the naked eye, but the material which the author analysed, when examined under the microscope, had all the appearance of a single substance, and it was not hygroscopic. The formula of the periodide is therefore $K_9Pb_4I_{19},10H_2O$, and it is probable that Wells, in assigning similar formulæ to the perbromide and the periodide, was led astray by the desire for uniformity.

84. "The molecular complexity of amides in various solvents." By Andrew Norman Meldrum and William Ernest Stephen Turner.

The authors have determined the molecular complexity by the boiling point method of eleven amides, namely, benzamide, salicylamide, acetanilide, benzanilide, acetamide, monochloroacetamide, dichloroacetamide, trichloroacetamide, trichlorolactamide, carbamide, and malonamide in six solvents, so far as the solubility of the amides would allow (compare *Proc.*, 1907, **23**, 165). The Lumsden-Walker apparatus was employed, and the boiling points were specially corrected for the mere pressure effect of the accumulation of liquid in the boiling tube. The following table summarises the results, and includes also the dielectric constants of the solvents :

Solvent.	Benzene.	Ether.	Chloroform.	Acetone.	Alcohol.	Water.
Number of amides investigated...	8	5	9	10	11	9
,, ,, which form simple molecules	1 doubtful	1	2	9	9	4 and 1 doubtful
,, ,, which form associated molecules	7	4	7	1	2 doubtful	4
Dielectric constant of solvent ...	2·3 at 18	4·4 at 18°	5 at 22°	25 at 20°	26 at 20°	80 at 17°

Except in the case of water, these results are in good accordance with the Nernst-Thomson theory that the smaller the dielectric constant of the solvent the greater is the association of the solute. Association in ether tends to be less than in benzene and much the same as in chloroform, just as would be inferred from the dielectric constant. Ether has hitherto been regarded as a non-associating solvent. In investigations into the physical properties of the amides and allied compounds, the most suitable solvent is alcohol, in which association is at a minimum.

Benzamide, salicylamide, acetanilide, and dichloroacetamide, the only instances of the kind known to the authors, have a greater molecular complexity in water than in alcohol. This is quite contrary to what would be expected from the Nernst-Thomson theory.

85. "The optical activity of compounds having simple molecular structure." By William Jackson Pope and John Read.

The authors described crystalline salts formed by chlorosulphoacetic acid and chlorobromomethanesulphonic acid with the optically active alkaloids, strychnine and quinidine. The two acids each contain an asymmetric carbon atom in the molecule, but, although their strychnine and quinidine salts crystallise well, no evidence was obtained that the acids are resolvable into enantiomorphously related components.

86. “Acetylketen: a polymeride of keten.” By Frances Chick and Norman Thomas Mortimer Wilsmore.

It has been shown (*Nature*, 1907, **75**, 510; *Trans.*, 1907, **91**, 1938) that keten, both in the liquid and the gaseous states, condenses at the ordinary temperature to form a pungent-smelling, brown liquid. The latter has now been further studied. On distillation, a colourless liquid passes over, leaving a brown, non-volatile residue. This liquid boils at 126—127°, and solidifies in a freezing mixture to a white solid, which melts at $-7°$ to $-6°$. It has an extremely pungent smell, suggestive both of acetic anhydride and of acrolein. On standing, even in absence of air, it slowly turns brown. Analysis gave $C = 56{\cdot}9$, $H = 5{\cdot}0$, whilst the depression of the freezing point of benzene and the vapour density, determined by Guy Lussac's method, agreed in giving a molecular weight of nearly 85, showing that the substance has the composition $C_4H_4O_2$, which requires $C = 57{\cdot}1$; $H = 4{\cdot}8$ per cent. M.W. = 84.

The liquid dissolves slowly in water, forming a strongly acid solution, which gives a violet colour with ferric chloride; on boiling the aqueous solution, carbon dioxide and acetone (recognised by the iodoform, benzaldehyde, and alkaline mercuric chloride reactions) are formed, and the solution becomes neutral. Hydrogen chloride facilitates the dissolution and decomposition. On boiling the substance with aqueous alkalis, acetates are formed, hence the substance combines with water to form acetoacetic acid. It reacts vigorously with aniline, forming acetoacetanilide melting at 84°.

The new substance is therefore *acetylketen*, having the formula $CH_3{\cdot}CO{\cdot}CH{:}CO$ or $CH_2{:}C(OH){\cdot}CH{:}CO$.

It reacts with two molecular proportions of phenylhydrazine, forming the colourless *phenylhydrazone-phenylhydrazide*, which melts at 152—153°.

87. “Saponification of ethyl formate by water in presence of acids as catalytic agents.” By Arthur Lapworth.

Some statements in a recent paper by Stieglitz (*Amer. Chem. J.*, 1908, **39**, 402) have led the author to re-examine a suspicion, which he had some reason to entertain some six years ago, but which he did not then succeed in fully confirming. In recent experiments the velocity of saponification of ethyl formate in acetone solution has been measured, hydrogen chloride being used as catalyst, and the water being present in quantity small enough to be comparable with that of the ester.

Set I.—
A = 10 c.c. ethyl formate, 2 c.c. water, made up with acetone to 50 c.c.
B = 10 c.c. ethyl formate, 5 c.c. water, made up with acetone to 50 c.c.

Titre of 5 c.c. :

t = 0.	4′.	10′.	27′.	59′.	2h 58′.	6h 28′.	22h 30′
A = (4·8)	6·1	7·5	10·45	16·35	36·3 (?)	41·40	43·2 c.c.
B = (4·8)	6·55	7·4	9·75	15·2	28·50 (?)	42·4	57·0 ,,

Set II.—
C = 10 c.c. ethyl formate, 5 c.c. water, made up with acetone to 50 c.c.
D = 10 c.c. ethyl formate, 10 c.c. water, made up with acetone to 50 c.c.

Titre of 5 c.c. :

t = 0.	1′.	6′.	29′.	2h 0′.	9h 18′.	21h 9′.
C = (2·5)	2·7	3·3	5·85	16 05	51·0	62·6 c.c.
D = (2·5)	2·5	3·0	5·75	15·8	48·9	72·5 ,,

Set III.—
E = 5 c.c. ethyl formate, 5 c.c. water, made up with acetone to 50 c.c.
F = 10 c.c. ethyl formate, 5 c.c. water, made up with acetone to 50 c.c.

Titre of 5 c.c. :

t = 0.	2′.	25′.	51′.	1h 5′.	1h 31′.	6h 20′.	18h 50′.
E = (4·0)	4·15	6·7	9·65	11·1	14·4	32·8	42·8 c.c.
F = (4·0)	4·4	8·45	15·10	17·95	25·45	53·7	65·1 ,,

The alkali used was about $N/10$, but was somewhat stronger in the case of Set I. The numbers under $t = 0$ indicate about the amount of each titre due to hydrochloric acid used as catalyst in each set.

The results show clearly enough that, in the circumstances specified, the velocity of saponification is nearly independent of the concentration of the water present during a considerable part of the change, but that, when the mixture approaches equilibrium conditions, divergence is noticed for the first time.

Stieglitz has shown (*loc. cit.*, p. 417) that his own theory leads to the expression

$$\frac{dx}{dt} = K \times k \times C_{\text{ester}} \times C_{\text{H}} \times [C_{\text{H}} \times C_{\text{OH}}]$$

or

$$= \text{proportional to } C_{\text{ester}} \times C_{\text{H}} \times C_{\text{water}},$$

and is therefore incorrect.

This chemist is also incorrect in asserting that the author's own theory (Mellor, *Chemical Studies and Dynamics*, p. 289) fails to account for the catalysis of esters by hydrogen ions; it remains the only theory in accordance with the facts, in spite of Stieglitz's remarks on the velocity of "salt formation" (*loc. cit.*, p. 425). It accounts for the dependence of the equilibrium condition on the concentration of the water, and the independence of the initial velocity of hydrolysis on that factor.

The author intends to continue with his colleague, the above work, and to study the influence of the concentration of alcohol and carboxylic acid on the velocity of esterification, as well as a number of analogous cases in which the influence of the substance generally used as solvent, is not fully understood.

88. "The triazo-group. Part III. Bistriazo-derivatives of ethane and of acetic ester." By Martin Onslow Forster, Hans Eduard Fierz, and Walter Philip Joshua.

1 : 2-*Bistriazoethane*, $N_3{\cdot}CH_2{\cdot}CH_2{\cdot}N_3$, prepared from ethylene dichloride and sodium azide, is a colourless, refractive liquid which boils at 53° under 9 mm. pressure, and has sp. gr. 1·178 compared with water at 19°; the odour resembles that of chloroform, and the vapour is explosive. Stannous chloride liberates two-thirds of the nitrogen, giving ethylenediamine; alcoholic alkali does not set free nitrogen, but slowly eliminates hydrazoic acid.

The *compound*, $C_{14}H_{16}N_6$, which probably has the constitution

$$C_6H_5{\cdot}NH{\cdot}N{:}N{\cdot}CH_2{\cdot}CH_2{\cdot}N{:}N{\cdot}NH{\cdot}C_6H_5,$$

arises by the action of magnesium phenyl bromide on 1 : 2-bistriazoethane, and crystallises from petroleum in lustrous, square plates with brown tinge; it melts at 128°, evolving gas with vigour. Dilute mineral acids liberate two-thirds of the nitrogen, producing aniline.

Bistriazoacetic ester, $CH(N_3)_2{\cdot}CO_2{\cdot}C_2H_5$, produced from dichloroacetic ester and sodium azide, is a colourless liquid which boils at 70—72° under 2 mm. pressure, and has sp. gr. 1·222 compared with water at 18°; the odour is scarcely perceptible. The ester is highly explosive, and liberates nitrogen explosively when treated with sulphuric acid. Hydrazoic acid is eliminated by alcoholic ammonia, consequently bistriazoacetamide could not be obtained.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

American Journal of Science and Arts. 2nd Series, Nos. 58—60, 77, 78, 94, 146—150. 3rd Series, Nos. 2—6. New Haven 1855—1871. (*Reference.*) From the Editor.

Society of Chemical Industry. Decennial Index of the Journal of the Society of Chemical Industry. Vols. XV to XXIV, 1896—1905. Part I, Index of Authors' Names. Compiled by *F. W.* **Renaut.** pp. 442. London 1907. (*Reference.*) From the Council.

Victoria. *Department of Agriculture.* Report . . . for the years 1905—07. pp. ix + 206. ill. Melbourne 1907. (*Recd.* 21/3/08.) From the Department.

II. *By Purchase.*

Kayser, *H.* Handbuch der Spectroscopie. Vol. 4. pp. 1248. Leipzig 1908. (*Recd.* 13/3/08.)

Zeitschrift für Chemie und Industrie der Kolloide. Edited by *Wolfgang* **Ostwald.** Year 2, etc. Dresden 1907 + . (*Reference.*)

III. *Pamphlets.*

Barrett, *W. H.* Wollaston: his life and work. (From the *J. Oxford University Junior Scientific Club*, 1907.)

Bihar Planters' Association. Report of the Indigo Research Station, Sirsiah (*under subsidy from the Government of Bengal*) for the year 1907—08. By *Cyril* **Bergtheil.** pp. 26. Calcutta 1908.

Dunlop, *Harry.* The testing of sperm oil and spermaceti. (From the *J. Soc. Chem. Ind.*, **27**, 1908.)

Friend, *J. Newton.* Ueber die Cupro-Verbindungen des Kohlenoxyds und die Ferro-Verbindungen des Stickoxyds. pp. 80. Würzburg 1908.

Lauder, *Alexander.* The variation in the composition of milk. Second annual report on the work at Rosslynlee, 1906—07. pp. 34. Edinburgh 1907.

New Zealand. *Department of Agriculture.* Chemistry division. Report, 1907. pp. 34. ill. Wellington 1907.

——— Bulletin No. 2. Wire-basket method of testing-soils. By *B. C.* **Aston.** pp. 11. ill. Wellington 1907.

Simon, *Theodor.* Ueber die Reduktion aromatischer Nitroverbindungen in saurer Lösung. pp. 76. Strassburg 1907.

At the next Ordinary Meeting, on **Thursday**, May **7th**, 1908, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :

"Interaction of diazonium salts with mono- and di-hydric phenols and with naphthols." By K. J. P. Orton and R. W. Everatt.

"Condensation of benzoin with methyl alcohol." By J. C. Irvine and D. McNicoll.

"Mutual solubility of α-methylpiperidine and water." By O. Flaschner and B. MacEwen.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 7th, 1908.

Allmand, Arthur John,

Central Laboratories, Widnes.

Chemist. Honours Graduate in Chemistry of the University of Liverpool; at present Research Chemist in the United Alkali Company, and Lecturer in Chemistry at Widnes Technical Schools.

F. G. Donnan. E. C. Weissmüller.
H. Bassett, jun. H. A. Auden.
Arthur Carey.

Baker, William Henry Benson,

Frognal Dene, Hampstead, N.W.

Student, Lincoln's Inn. B.A. Oxford; Honours in Final Chemistry School, 1906.

J. E. Marsh. W. W. Fisher.
T. V. Barker. A. Angel.
A. F. Walden.

Bowen, Josiah Leonard,

8, West Field, Lightcliffe, near Halifax.

Analytical Chemist. Studied Metallurgy and Analysis of Steel under tuition, and in the Laboratory, of F. J. Merrils, F.C.S., Sheffield. Studied Analytical Chemistry for five years under the tuition, and in the Laboratory, of F. W. Richardson, F.I.C., County Analyst to W.R.C.C., Yorkshire. Since April 1st, 1907, Research Chemist to

Messrs. Richardson and Jaffé, Analytical Chemists, Bradford. Researches upon "The Estimation of Adulterants in Turpentine." Co-author with F. W. Richardson, F.I.C., of a Paper "Determination of Mineral Acids in Vinegar" (*J. Soc. Chem. Ind.*, XXV., 17, 15/9/06).

A. Jaffé.
Fredk. J. Merrils.
F. W. Richardson.
Walter M. Gardner.
B. North.
Walter Leach.

Coverdale, Arthur Edward,

68, Broad Street, Worcester.

Pharmaceutical Chemist. Studied Chemistry under Dr. John Muter, F.I.C., F.C.S.; passed the minor and major examinations of the Pharmaceutical Society of Great Britain; conducts Analyses, and desires to keep in touch with the progress of chemistry and research.

John Muter.
A. H. M. Muter.
F. H. Alcock.
W. L. Howie.
Thomas Tyrer.
David Howard.
Peter MacEwan.

Findley, Albert Edward,

1, Welford Road, Handsworth, Birmingham.

Demonstrator in Chemistry at Bradford Technical College. B.Sc. (Birmingham), Chemistry (principal subject) and Physics.

Percy F. Frankland.
Hamilton McCombie.
Alex. Findlay.
Thos. J. Murray.
C. K. Tinkler.
Walter M. Gardner.
Barker North.

Gilling, Charles,

30, Carnarvon Road, Barnet.

Chemist. Pharmaceutical Chemist. Redwood Research Scholar of Pharmaceutical Society.

Arthur W. Crossley.
Chas. Horne Warner.
J. Stuart Hills.
M. Carteighe.
Walter Hills.

Green, Leonard Clifford,

Wienholt Street, Torwood, Brisbane, Queensland.

Lecturer in Chemistry at the Brisbane Technical College. Sydney University Senior Examination in Chemistry. Lecturer in Chemistry and Metallurgy, Brisbane Technical College. Analytical Chemist (professionally). Final 3rd Year Metallurgy B.E. degree, Sydney University, 1901.

J. C. Brünnich, F.I.C.
J. Brownlie Henderson, F.I.C.
P. W. Jones, A.I.C.
Hardolph Wasteneys.
A. B. Chater.

Hall, William,

Inglewhite, Manchester Road, Bolton.

Science Master. B.Sc. (Victoria University of Manchester); Chemistry was one of final subjects. Have taught the subject in Secondary Schools since 1897.

W. H. Perkin.
J. F. Thorpe.
Alfred Holt, jun.
G. H. Bailey.
Norman Smith.

Holden, George Edward,

23, Durnford St., Middleton, Manchester.

Works Chemist. Honours in Chemistry; Lecturer on Dyeing, Middleton. Diploma of the Municipal School of Technology. 1st class Hons., full Technological certificates, for Dyeing, Bleaching, Printing, Oils and Fats, 1st Coal Tar, &c.

W. J. Pope.
Jas. Grant.
Stanley J. Peachey.
L. G. Radcliffe.
John Allan.
F. S. Sinnatt.

Hornby, Percy Holme,

111, Nine Elms Lane, S.W.

Chemist to the Brentford Gas Co. Studied Chemistry under Mr. J. Hornby, F.I.C. Held the position of chemist to the Ilford Gas Co. for 3½ years. At present occupy the position of chemist to the Brentford Gas Co. Have devoted considerable time to original research, more particularly cyanides.

S. G. Rawson.
J. Wilson.
W. J. Atkinson Butterfield.
Charles A. Keane.
Bertram Blount.

Kohn, Hugo Stefan, Ph.D.,

3A, Hythe Road, Willesden Junction.

Works Manager. I studied Chemistry at the Universities of Munich and Berlin; at the latter I took my degree in 1902 by the investigation, "Beitrag zum Abbau von Zuckern; Darstellung der *l*-Threose und der Methyltetrose," as published in the *Berichte d. dtsch. chem. Gesellsch.*

R. Lessing.
Otto Oberländer.
E. P. Andreae.
R. W. Sindall.
A. Hann.

Lynch, Gerald Roche,

160, Holland Park Avenue, W.

Advanced student at the Central Technical College, South

Kensington. Joint author with N. H. Alcock of "The Relation between the Physical and Chemical Properties of the Nerves. Part I," from *Journal of Physiology.*

Henry E. Armstrong.
William A. Davis.
Gerald T. Moody.
George Senter.
W. Robertson.
Robert J. Caldwell.

Mansfield, Herbert,

70, Stapleton Hall Rd., Stroud Green, N.

Analytical Chemist. Bachelor of Science of the London University, with Honours in Chemistry. Associate of the Institute of Chemistry. Assistant to Dr. Frank L. Teed. Deputy Gas Examiner to the London County Council. At present engaged on research at the East London College.

Frank L. Teed.
J. T. Hewitt.
Clarence Smith.
J. J. Fox.
Horace Finnemore.

Maywald, Frederick J.,

1028, 72nd Street, Brooklyn, N.Y., U.S.A.

Consulting and Research Chemist. I have been associated with the late Dr. Peter T. Austen in the above lines of work for 14 years, and have worked out various processes which have since been patented.

T. Lynton Briggs.
Marston T. Bogert.
J. Livingston R. Morgan.
C. F. Chandler.
William S. Myers.

Meade, Alwyne Harcourt,

Cedar House, St. Neots, Huntingdonshire.

Gas Engineer. Studied chemistry for 4 years at Oundle College, Northants. Oxford and Cambridge Certificate (first class pass in chemistry). City and Guilds of London Institute—first class honours pass in Gas Engineering. Assistant to Commercial Gas Company London.

Thos. R. Duggan.
H. F. Hills.
Harold G. Colman.
H. O. Hale.
H. Leicester Greville.
F. Napier Sutton.
W. J. Atkinson Butterfield.
Vivian B. Lewes.
Samuel Rideal.
Kenneth M. Chance.

Melling, Samuel Ernest,

The Cliff, Higher Broughton, Manchester.

Analytical chemist. Fellow of the Institute of Chemistry. Student at Owens College, Manchester, 1894–7. Five years with the late Mr. A. H. Allen, and for the past five years in partnership with Mr. J. Carter Bell, County and Public Analyst. Public Analyst for the County Borough of Wigan. Deputy Agricultural Analyst for the County of Chester, &c.

J. Carter Bell.
Otto Hehner.
Edward Bevan.
Alf. C. Chapman.
Arthur E. Ekins.
G. E. Scott-Smith.

Neech, Herbert Richard,

20, Colegrave Street, Lincoln.

Analytical Chemist and Chemical Engineer. Studied Chemistry (inorganic and organic) for five years at the Lincoln School of Science. Hold South Kensington First Class Advanced Certificates for Chemistry (Theoretical and Practical) and other Sciences, also City and Guilds Certificate for Electrical Engineering. Have acted as Assistant Chemist to Messrs. Morris Brothers, Doncaster, for nine years. Occupied position of Chemist to Productos Quimicos de Huelva, S.A., for eighteen months. At present Consulting Chemist in Lincoln. Am interested in all branches of Chemistry, and am desirous of obtaining the Society's Journals and publications.

John Shields.
Clarence H. Creasey.
J. Hope Belcher.
Wm. T. Gent.
Walter Birkett.

Phillips, Thomas Richards,

Stanhope House, Abergavenny.

Inspector of Inland Revenue. First class Organic and Inorganic Chemistry, Royal College of Science, South Kensington. Three years Assistant in the Government Laboratory, London. Interested in Chemical Science.

E. Grant Hooper.
C. Proctor.
J. H. Robbins.
E. Jones.
J. Woodward.
Geo. Stubbs.
J. J. Fox.

Richards, Francis Edward,

County Secondary School, Redruth.

Science Master at the County School, Redruth. Joint Author, with Dr. G. T. Morgan, of a paper on "Azo-colouring matters derived from *as*-Tetrahydro-α-naphthylamine" (*Journ. Soc. Chem. Ind.*, June 30, 1905). Chemistry teacher as above. A.R.C.S. (London) in Chemistry and B.Sc. (Lond.) Hons. in Chemistry.

William A. Tilden.
M. O. Forster.
James C. Philip.
Chapman Jones.
G. T. Morgan.

Watkins, Edwin John,

10, Montpelier Road, Queens Road, Peckham, S.E.

Analyst and Technical Chemist; engaged in the manufacture of Cereal and Malted Food Products; at present with Mellin's Food Ltd., Peckham, London, S.E. Student—Chemistry, Physics—during five years at St. Thomas Charterhouse Science Schools; also three years at Borough Polytechnic Laboratories. Bacteriology, two sessions, King's College. Assistant and Demonstrator to J. J. Pilley, Ph.D. Member of Society of Chemical Industry. Author of "Investigations Touching the Cause of Rope Disease in Flour and Bread" (*Journ. Soc. Chem. Ind.*, 1906, 8, 350—357). Author of articles on Chemistry in *Modern Baker, Confectioner, &c.*, London, 1907. Also many articles on chemistry in bakery trade journals.

John J. Pilley.
F. Mollwo Perkin.
D. S. Kemp.
John B. Coppock.
Alfred Gordon Salamon.
Julian L. Baker.

Wheatley, William,

21, Bairstow Street, Preston.

Science Master, Preston Grammar School. B.A., 2nd Class Honours, Chemistry, Oxford, 1907.

W. W. Fisher.
J. E. Marsh.
John Watts.
Allan F. Walden.
A. Angel.
N. V. Sidgwick.

The following Certificates have been authorised by the Council under Bye-Law 1 (3):

Dutt, Bidhu Bhushan,

Calcutta.

Lecturer in Chemistry, Presidency College, Calcutta. M.A. in Chemistry of Calcutta University. Author of a Paper on "Reactions at Low Temperatures," published in the Proceedings of the Asiatic Society of Bengal. Assistant in the Chemical Department at Presidency College, Calcutta, during the last three years.

J. A. Cunningham.
P. C. Rây.
E. R. Watson.

Ganguli, Atul Chandra,

Cuttack, Orissa, India.

Professor of Chemistry, Ravenshaw College, Cuttack. B.A. of Calcutta University, with Honours in Chemistry and Physics. Joint author (with Prof. P. C. Rây, D.Sc.) of several papers published in the Transactions of the Chemical Society. For many years Assistant in the Chemical Department, Presidency College, Calcutta.

J. A. Cunningham. P. C. Rây.
E. R. Watson.

Hinds, Cyril Arden,

724, Russell Street, Bristol, Tenn., U.S.A.

Chief Chemist, Bristol Barium and Zinc Works, John T. Williams and Son, props. Student in Science Department at Harrison College, Barbados, for 5½ years, during which time chemistry, theoretical and practical, was one of the subjects studied; junior assistant for 10 months at Govt. Laby., Barbados. At present as above *vide* occupation.

J. P. d'Albuquerque. John R. Bovell.
E. Gillman.

Horrobin, Arthur,

Ajmer, Rajputana, India.

Analytical Chemist. Five years as Assistant in Laboratory of the "Lancashire and Yorkshire Railway Company"; two years in charge of Electrochemical department of "The Chloride Electrical Storage Company's" works, Lancashire; four and a-half years Chief Assistant Chemist "East Indian Railway Company," and now Chemist to "Bombay, Baroda, and Central India Railway Company"; I am desirous of obtaining Journal and keeping in touch with the advancement of chemical science.

Chas. J. P. Fuller.

Neogi, Panchānan,

Rajshahi, Eastern Bengal and Assam.

Professor of Chemistry, Rajshahi College. M.A. in Chemistry, Calcutta University, and Premchand Roychand Research Scholar, 1906. Author of Papers published in the Transactions of the Chemical Society and the Proceedings of the Asiatic Society of Bengal.

J. A. Cunningham. P. C. Rây.
E. R. Watson.

Seelhorst, William,

Chemist to the Eastern Smelting Co., Ltd., Penang, Straits Settlements. Previously for eight years senior Laboratory Assistant in the Government Laboratory, Singapore, S.S., under Mr. Percival J. Burgess, M.A., F.C.S., and Dr. Frankland Dent, M.Sc., Ph.D., F.I.C., J.P., and Mr. John R. Brooke, F.I.C., F.C.S., J.P. Reasons the applicant desires to become a Fellow: To keep abreast of current chemical literature, of which there is little in the Colony.

John R. Brooke.

RICHARD CLAY AND SONS, LIMITED, BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 18/5/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 341

Thursday, May 7th, 1908, at 8.30 p.m., Professor E. DIVERS, F.R.S., in the Chair.

Mr. K. S. Caldwell was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Charles Duncan Cooper, 776, Oxford Road, Reading.
John Robert Cowburn, Belmont Villa, Birkbeck Grove, Acton, W.
Kaufman George Falk, B.Sc., Ph.D., 1070, Madison Avenue, New York City.
Norman Holland, 4907, Sherbrooke Street W., Montreal.
James Kirkman King, B.A., 55, Brewery Road, Plumstead.
Lionel Gordon Larmuth, Grove House, Cheadle Hulme, Manchester.
Henry Robert Lyell, Redcott, Dacres Road, Sydenham, S.E.
Haradhan Ray, M.A., 4, Jhamapooker Lane, Calcutta.
William Readwin, 6, Kirkfield Terrace, Morley, near Leeds.
Alexander Mackintosh Stewart, Penang, Straits Settlements.
Herbert Horace Ward, University College of Wales, Aberystwyth.
Charles Harold Wright, B.A., Government Laboratory, Port of Spain, Trinidad.
Charles Robert Young, B.Sc., 11, Low Pavement, Nottingham.

A Ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Arthur John Allmand, M.Sc.
William Henry Benson Baker, B.A.
Josiah Leonard Bowen.
Arthur Edward Coverdale.
Bidhu Bhushan Dutt, M.A.
Albert Edward Findley, B.Sc.
Atul Chandra Gañguli, B.A.
Charles Gilling.
Leonard Clifford Green, B.E.
William Hall, B.Sc.
Cyril Arden Hinds.
George Edward Holden.
Percy Hulme Hornby.
Arthur Horrobin.
Hugo Stefan Kohn, Ph.D.
Gerald Roche Lynch.
Herbert Mansfield, B.Sc.
Frederick J. Maywald.
Alwyne Harcourt Meade.
Samuel Ernest Melling.
Herbert Richard Neech.
Pañchānan Neogi, M.A.
Thomas Richards Phillips.
Francis Edward Richards, B.Sc.
William Seelhorst.
Edwin John Watkins.
William Wheatley, B.A.

Of the following papers, those marked * were read:—

*89. "The refraction and dispersion of triazo-compounds."

By James Charles Philip.

The molecular refraction and dispersion of a number of compounds containing the triazo-group have been determined. A study of these constants shows that the contribution which the N_3-group normally makes to the molecular refraction is 8·91 units, almost the same value as the atomic refraction of bromine. The contribution which the N_3-group normally makes to the molecular dispersion is 0·36—0·37, whilst the atomic dispersion of bromine is 0·35. In certain compounds, namely, ethyl triazoformate, phenylazoimide, and α-naphthylazoimide, the refractive and dispersive powers of the N_3-group are considerably above the normal values. Such "optical exaltation" (Brühl, *Ber.*, 1907, **40**, 878) is generally associated with the existence in the molecule of contiguous unsaturated groups, and it will be seen that in each of the three triazo-compounds mentioned the N_3-group is in conjugation with an unsaturated group. The bearing of these results on the formulation of the N_3-group was discussed.

*90. "The dissociation constants of triazoacetic and α-triazopropionic acids."

By James Charles Philip.

The conductivity of solutions of these acids has been determined in the usual way. The values obtained for the expression $k = \alpha^2/(1-\alpha)v$ diminish to some extent as the dilution increases, but are sufficiently constant to indicate the strengths of the two acids. The value of k

for triazoacetic acid is 0·00090—0·00100, whilst that for α-triazopropionic acid is slightly less, about 0·00086. These values show that the introduction of the N_3-group into the molecule of acetic or propionic acid increases the strength of the acid nearly as much as the introduction of a bromine atom. It is noteworthy, also, that the conductivity of the triazoacetate ion is the same as that of the monobromoacetate ion.

Discussion.

Mr. H. Stanley Redgrove called attention to a paper (*Chem. News*, 1907, **95**, 193) in which he proved that in general the alleged atomic constants employed in calculating additive physicochemical constants (such as Brühl's mol.-refractivity constants) were incorrect and, in the present state of our knowledge, unobtainable.

This was due to the fact that the specific influence due to certain linkings (for example, the "ethane" carbon linking) is neglected. In the paper quoted, he had outlined a general method of calculation by means of the so-called "fundamental constants," whereby the above assumption is avoided, and was applying it with success to the calculation of thermal constants.

Allowing for this, Brühl's hydrogen constant was really the value of the hydrogen atom plus the C·H link decreased by half the value of a C·C link, and his carbon constant the value of the carbon atom increased by twice the value of a C·C link, &c., so that the triazo-constant would be the value of the triazo-group plus the link joining it to carbon decreased by half the value of a C·C link.

*91. "The fermentation of mannose and lævulose by yeast-juice." (Preliminary note.) By Arthur Harden and William John Young.

1. Mannose is fermented by yeast-juice at almost the same rate as dextrose.

2. Lævulose is fermented somewhat more rapidly than dextrose, the rate varying with different samples of yeast-juice from 1·2 to 1·8, compared with that of dextrose = 1.

3. Mannose and lævulose behave qualitatively towards phosphates in the presence of yeast-juice in a similar manner to dextrose.

(*a*) When a phosphate is added to a fermenting mixture containing either of these sugars, the phosphate is converted into a hexosephosphate not precipitable by magnesia mixture; the rate of fermentation is temporarily greatly accelerated, and during this period an extra amount of carbon dioxide is evolved, equivalent to the phosphate added:

the rate then rapidly diminishes, and falls to a value equal to, or slightly greater than, that which it had before the addition of the phosphate.

The fermentation of mannose and lævulose by yeast-juice therefore probably proceeds according to the same two equations as have been previously proposed by the authors for dextrose:

(1) $2C_6H_{12}O_6 + 2R_2'HPO_4 = 2CO_2 + 2C_2H_6O + C_6H_{10}O_4(PO_4R_2')_2 + 2H_2O$.

(2) $C_6H_{10}O_4(PO_4R_2')_2 + 2H_2O = C_6H_{12}O_6 + 2R_2'HPO_4$.

(*b*) As in the case of dextrose, an optimum concentration of phosphate exists, which produces a maximum rate of fermentation. Increase of concentration beyond this maximum diminishes the rate of fermentation produced, until, with a sufficiently great concentration of phosphate, the rate is less than that of the juice in the absence of added phosphate.

4. The quantitative relations of mannose to phosphates are practically the same as those of dextrose.

The maximum rate produced by lævulose, on the other hand, is much greater than (about double) that produced by dextrose or mannose. The accelerated fermentation of lævulose in presence of phosphate, moreover, is much less readily inhibited than that of dextrose or mannose by the further addition of phosphate, the difference in this respect being very marked.

5. Lævulose possesses the property of inducing rapid fermentation in a mixture of dextrose or mannose with yeast-juice, in which fermentation has been inhibited by a large excess of phosphate and in which the concentration of free phosphate is maintained constant throughout the experiment. Dextrose and mannose have not a similar power. The amount of lævulose required to produce this effect is comparatively small. Thus, for a mixture of 15 c.c. of yeast-juice with 15 c.c. of a 0·6 molar solution of potassium phosphate and 2 grams of dextrose fermenting at the rate of 0·7 c.c. per five minutes, the addition of 0·05 gram of lævulose was found to be sufficient, the maximum rate produced being 17 c.c. per five minutes. The effect is not due to the preferential fermentation of the lævulose, as the amount of gas evolved far exceeds that which could be derived from this source.

The nature of this reaction is still under investigation.

DISCUSSION.

Mr. GRANT HOOPER asked if Dr. Harden had examined the effect of phosphates on yeast as distinct from yeast-juice. In view of the fact that phosphates had been often used in the so-called "Yeast Foods" offered to or employed by brewers, it would be interesting to know whether the authors had observed whether the addition of phosphate to normal fermentations with yeast had the same effect as when added to yeast-juice.

Dr. HARDEN, in his reply, said that Slator had recently observed that the fermentation caused by yeast was not accelerated by phosphate.

*92. "The constituents of olive leaves." By Frederick Belding Power and Frank Tutin.

Air-dried olive leaves were percolated with hot alcohol, when they gave about 30 per cent. of their weight of extracted material. This alcoholic extract yielded, besides some amorphous matter, the following products:

(1) A new *monocarboxylic acid*, $C_{22}H_{45}\cdot CO_2H$ (m. p. 68—69°); (2) a small amount of a mixture of fatty acids, containing oleic acid; (3) hentriacontane, $C_{31}H_{64}$ (m. p. 68—69°); (4) pentatriacontane, $C_{35}H_{72}$ (m. p. 74·5°); (5) *oleasterol*, $C_{20}H_{34}O$ (m. p. 174°), a new, crystalline alcohol related to the phytosterols; (6) a new, crystalline alcohol, *olestranol*, $C_{25}H_{42}O_2$ (m. p. 217—218°), which appears to be a hydroxyphytosterol; (7) *homo-olestranol*, $C_{27}H_{46}O_2$ (m. p. 210°; $[\alpha]_D$ +71°), a compound similar to olestranol; (8) an amount of *d*-mannitol equivalent to about 3·4 per cent. of the weight of air-dried leaves; (9) a considerable amount of a sugar which yields *d*-phenylglucosazone; (10) a trace of an essential oil; (11) *oleanol*, $C_{31}H_{48}O(OH)_2,H_2O$ (m. p. 303—304°; $[\alpha]_D$ +78·3°), a new, crystalline substance in an amount equivalent to nearly 3·4 per cent. of the weight of air-dried leaves. This compound contains one alcoholic and one phenolic hydroxyl group. *Monomethyloleanol*, $C_{31}H_{48}O(OH)\cdot O\cdot CH_3$, melts at 194—195°, and on acetylation yields *acetylmethyloleanol*, $C_{31}H_{48}O_2(O\cdot CH_3)\cdot CO\cdot CH_3$ (m. p. 215·5°). *Diacetyloleanol*, $C_{31}H_{48}O_3(CO\cdot CH_3)_2$, when heated to about 210°, gives a *substance*, $C_{31}H_{48}O_3$, which does not fuse at 310°. *Monoacetyloleanol*, $C_{31}H_{48}O_2(OH)\cdot CO\cdot CH_3$, melts at 258°.

*93. "The constituents of olive bark." By Frederick Belding Power and Frank Tutin.

Air-dried olive bark, on percolation with hot alcohol, yielded about 30 per cent. of its weight of extracted material. From this alcoholic extract the following crystalline compounds were obtained, together with some amorphous products.

(1) A new *monocarboxylic acid*, $C_{34}H_{67}\cdot CO_2H$ (m. p. 69—70°), which yields an *ethyl* ester melting at 63°; (2) a new *monocarboxylic acid*, $C_{24}H_{45}\cdot CO_2H$ (m. p. 79°), the *ethyl* ester of which melts at 66·5°;

(3) a new *monocarboxylic acid*, $C_{34}H_{69}\cdot CO_2H$ (m. p. 92°), which yields an *ethyl* ester melting at 87°; (4) a new *monocarboxylic acid*,

$$C_{29}H_{57}\cdot CO_2H$$

(m. p. 84°), the *ethyl* ester of which melts at 75°; (5) a *substance*, probably a *tertiary alcohol*, $C_{35}H_{68}O$ (m. p. 70°); (6) pentatriacontane, $C_{35}H_{72}$ (m. p. 74—75°); (7) a phytosterol, $C_{27}H_{46}O$ (m. p. 136°; $[\alpha]_D - 35\cdot2°$), which yields an acetyl derivative melting at 119·5°; (8) a *substance*, $C_{23}H_{38}O_2(OH)_2$ (m. p. 285—290°), which yields an *acetyl* derivative melting at 160°, and is identical with *ipuranol*, a compound recently isolated by Power and Rogerson from *Ipomoea purpurea*; (9) a new phenolic substance, *olenitol*, $C_{14}H_{10}O_6$ (m. p. 265°), dilute solutions of which show a blue fluorescence. *Acetylolenitol* melts at 130°; (10) *d*-mannitol, in an amount equivalent to 1·9 per cent. of the weight of air-dried bark; (11) a sugar which yields *d*-phenylglucosazone.

94. "The reaction of diazonium salts with mono- and di-hydric phenols and with naphthols." By Kennedy Joseph Previté Orton and Reginald William Everatt.

The behaviour of a series of typical diazonium salts, mainly hydrogen sulphates, with phenols in alcohol, water, and other solvents has been examined. All diazonium salts couple quantitatively with α- and β-naphthols in alcoholic media, but under similar conditions these salts do not combine with monohydric phenols.

The dihydric phenols, resorcinol and orcinol, resemble the naphthols, reacting readily with all diazonium salts in alcoholic solution. In aqueous solution, on the other hand, only those diazonium salts with a preponderance of negative substituents (halogen atoms) in the benzene nucleus couple completely with the two dihydric phenols. In other cases, unless the acidity has been reduced by sodium acetate, the coupling is either partial or absent, according to the character of the substituents of the benzene nucleus.

It is a remarkable fact that those diazonium salts possessing halogen atoms in the positions 2, 4, and 6 with respect to the diazo-group (for example, *s*-tribromodiazobenzene) will react rapidly and quantitatively with resorcinol and orcinol in solution in 50 per cent. sulphuric acid.

Diazonium salts are converted by quinol in aqueous or alcoholic solution into the corresponding hydrocarbon, thus:

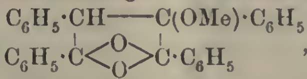
$$Ar\cdot N_2HSO_4 + OH\cdot C_6H_4\cdot OH = ArH + N_2 + H_2SO_4 + O{:}C_6H_4{:}O.$$

With catechol, either coupling or a similar reaction to that with quinol takes place, according to the nature of the substituents in the benzene nucleus of the diazonium salt.

A number of azoresorcinols and azo-orcinols were described.

95. "The condensation of benzoin with methyl alcohol."

By James Colquhoun Irvine and David McNicoll.

It has already been noticed (*Trans.*, 1907, **91**, 1384) that during the methylation of benzoin by Fischer's method two by-products (m. p. 185° and 285°) are formed in varying quantity, according to the conditions of the reaction. As one of the compounds appeared to be produced by the condensation of benzoin methyl ether, the constitution and mode of formation of both substances have been further examined. The results show that the compounds are tetraphenylfuran derivatives, and the formulæ previously suggested are therefore no longer tenable. Both substances give the same triacetyl derivative when treated with acetic anhydride and sulphuric acid in the cold, and this in turn, when warmed with the reagent, is converted into acicular dibenzoylstilbene. The compound of lower melting point is converted into the other by the action of methyl alcohol and hydrogen chloride, and both substances are formed when dibenzoylstilbene is subjected to a similar reaction. The compound melting at 185° is thus regarded as *aβ-dibenzoyl-a-methoxydibenzyl*,  $\begin{array}{l} C_6H_5\cdot CH \text{——} C(OMe)\cdot C_6H_5 \\ C_6H_5\cdot \overset{|}{C}<{}^{O}_{O}>\overset{|}{C}\cdot C_6H_5 \end{array}$, and the second compound (m. p. 285°) as 2-*hydroxy*-3 : 5-*dimethoxytetraphenyltetrahydrofuran*, conclusions which are supported by the action of hydrogen iodide on each. Apparently the formation of the compounds takes place during the methylation prior to the formation of benzoin methyl ether, and is doubtless owing to the dehydration of the benzoin to form dibenzoylstilbene, which then unites with two molecules of methyl alcohol in two successive stages.

The occurrence of similar side reactions has also been noticed in the methylation of anisoin.

96. "The mutual solubility of 2-methylpiperidine and water."

By Otto Flaschner and Basil MacEwen.

The influence of constitution on one of the two critical solution temperatures of mutually soluble liquids was discussed. Nitrogen and oxygen atoms increase the mutual solubility when one of the liquids is water, whilst carbon and hydrogen atoms decrease it. In order to ascertain the influence of the position of a substituted group in a cyclic compound, the mutual solubility of 2-methylpiperidine and water has been examined. This is represented by a closed curve. The lower critical solution temperature is 79°, and the higher one 227°.

97. "The melting points of the anilides, *p*-toluidides, and *a*-naphthalides of the normal fatty acids." By Philip Wilfred Robertson.

The melting points of the fatty amides do not exhibit any regularity even if the odd or even members are considered separately. The anilides also show the same exceptional behaviour, and, in order to obtain a more definite insight into the relationship between melting point and number of carbon atoms in a homologous series, the missing members have been prepared as well as a complete series of the *p*-toluidides. The irregularities in these two series seem to tend always in the reverse direction to those observed in the case of the amides. On taking the mean melting points of the amides and anilides, and of the amides and *p*-toluidides, the disturbing factor, which is considered to be a function of the lack of symmetry of the molecule, is to a great extent eliminated, as regular series of numbers are obtained.

In the fatty *a*-naphthalides, where the substituent group is heavier, irregularities tend to disappear: the melting points of the even members descend to a minimum at the eighth member and then rise gradually, whilst there is a corresponding minimum in the case of the odd series at the ninth member.

98. "The absorption spectrum of camphor."
By Walter Noel Hartley.

The absorption spectrum of solutions of camphor was examined in 1881 (Hartley, *Trans.*, **39**, 153) and compared with the spectra of benzene and its derivatives. There was a difficulty in obtaining it free from impurities showing absorption bands. Camphor sublimed in sunlight and condensed in large crystals, showed no band, and was remarkably diactinic. In view of more recent work, it was decided to re-examine the spectrum of camphor very carefully. The result has been to show that when solutions of ten times the concentration usually employed in such experiments are examined, a band occurs in the spectrum, due to the occurrence of the CO and CH_2 groups in the molecule. This is in general agreement with the work of Baly, Marsden, and Stewart (*Trans.*, 1906, **89**, 979), but otherwise the substance is remarkably diactinic.

99. "The viscosity of solutions." By Charles Edward Fawsitt.

In continuation of previous work (*Zeitsch. physikal. Chem.*, 1904, **48**, 585; *Electrochemist and Metallurgist*, 1904, **3**, 664), a number of colloidal solutions and alcoholic solutions have been examined. In dilute solutions, the viscosity is, in general, a linear function of the concentration. If the viscosities of solutions of the substances in a homologous series are compared, the relation of viscosity to composition appears to be largely additive.

100. "The action of fused potassium hydroxide and of hydrogen peroxide on cholesterol." (Preliminary note.) By Robert Howson Pickard and Joseph Yates.

Cholesterol is slowly decomposed by prolonged fusion with potassium hydroxide. From the products of the decomposition, small quantities of two crystalline acids have been isolated. The *acid*, $C_{26}H_{44}(OH)\cdot CO_2H$, melts at 241°, is optically active, and forms an *acetyl* derivative (m. p. 163°) and an *ethyl* ester (m. p. 62°). The *acid*, $C_{24}H_{42}(CO_2H)_2$, melts at 190°, and forms an amorphous *silver* salt.

Cholesterol or its acetate is also rapidly attacked by hydrogen peroxide, which is employed to the best advantage under the conditions described by W. H. Perkin, jun. (*Proc.*, 1907, **23**, 166). The main product is a neutral *substance*, $C_{27}H_{46}(\text{or }_{48})O_3$, m. p. 239°, which is probably isomeric with dehydrocholestantriol (Windaus, *Ber.*, 1907, **40**, 257). The *monoacetate* melts at 212°, the *diacetate* at 165°, and the *dipropionate* at 172°. It may be oxidised to a *keto-alcohol*, $C_{27}H_{44}O_3$ (m. p. 232°), which forms a *monoacetate*, m. p. 233°, and a *phenylhydrazone*, m. p. 164°. The substances melting at 239° and 232° contain the hydroxyl group of cholesterol, and are readily oxidised to the diketo-alcohol ("oxycholestendiol") described by Mauthner and Suida (*Monatsh.*, 1896, **17**, 590). Dicholesteryl ether behaves in an analogous manner with hydrogen peroxide, forming a neutral *substance*, $(C_{27}H_{45}O_2)_2O$ (?), which melts at 192° and forms a *diacetate*, m. p. 143°. The formation of these substances appears to confirm the deductions of Windaus (see summary in *Arch. Pharm.*, 1908, **246**, 117) as to the relation between the constitution of cholesterol and that of some of the products of its oxidation by permanganic and chromic acids.

101. "The volumetric estimation of silver." By William Robert Lang and J. C. Woodhouse.

The apparatus employed for the estimation of sulphates and salts of barium (*Trans.*, 1907, 91, 1370) was found unsuitable for the determination of silver, owing to the slowness with which the milky solution in the thin tube cleared. Some filtering medium appeared necessary, so, after several unsuccessful attempts with glass-wool and with asbestos, clean sand was used, held in position by a glass-wool plug in a curved tube. The packed sand filter necessitated the use of a filter-pump for washing, and was found a great convenience. Experiments were made with solutions containing a known amount (0·5 gram) of silver, to which an excess of $N/10$ sodium chloride was added and the excess titrated with $N/10$ silver nitrate. Each titration occupied about half an hour, and the mean error of six determinations was 0·286 per cent. On using 1 gram of silver, 100 c.c. of $N/10$ sodium chloride, and titrating back with $N/100$ silver nitrate, the error was reduced to 0·198 per cent. The effect of free nitric acid in varying amounts on the estimation was also tried and found to reduce the error still further, as low as 0·063 per cent The method and apparatus were then employed to determine silver in bullion under the same conditions as obtained in the Gay-Lussac method, namely, 1 gram of silver in nitric acid, 100 c.c. of $N/10$ sodium chloride, and finishing with $N/100$ silver nitrate. The result of seven estimations done in this way, each occupying about half an hour, gave a mean error of 0·067 per cent. It seems reasonable to hope that this apparatus may prove of use to those requiring a rapid and accurate method of estimating silver.

102. "A criticism of Werner's theory, and the constitution of complex salts." By John Albert Newton Friend.

The author pointed out the disadvantages of Werner's theory, as applied to simple and complex salts, and suggested new structural formulæ which are free from these objections.

103. "The action between potassium sulphite and potassium pentathionate." By Edward Divers.

Debus published, in 1888, a paper on the polythionic acids (*Trans.*, 53, 278), which is still a classic on the subject, but can remain so only so long as later researches leave its accuracy in all essentials untouched. It is therefore important to point out that the accuracy of Debus's investigation of the action between a sulphite and a pentathionate is not affected by Colefax's quite recent work (*Trans.*, 1908, **93**, 798), as it would appear to be from pp. 803—804 of that author's paper. Debus is in agreement with Colefax, but his work is more comprehensive than Colefax's and with a wider object in view.

Colefax has found that potassium sulphite in solution is, nearly all, rapidly converted by potassium pentathionate into the thiosulphate, whilst Debus has stated (*loc. cit.*, p. 344) that "potassic sulphite and potassic pentathionate form potassic thiosulphate and potassic trithionate." The latter author's experimental proof of this is given on p. 332, but in an irregular form, for, instead of using potassium sulphite, he dissolved the potassium pentathionate in a concentrated solution of sulphur dioxide and then added barium carbonate. He gives two chemical equations in explanation of this procedure, which are equivalent to $K_2S_5O_6 + 2K_2SO_3 = K_2S_3O_6 + 2K_2S_2O_3$, an equation indicating a 50 per cent. fall in iodine titration-value, in accordance with Colefax's observations. By using barium carbonate, Debus accomplished an easy separation of the products, obtaining the thiosulphate as insoluble barium salt, and the trithionate as potassium salt, in crystals. Colefax worked throughout his investigations on molecular proportions of his salts, as was proper for the end he had in view, but the addition to the above equation of a second molecule of pentathionate is without effect on the action it expresses or on the iodine value. Working quantitatively, and with the actual salts, Colefax has made, it should be added, a real addition to our knowledge of the reaction.

Debus did experiment with potassium sulphite itself, converting it into thiosulphate by the pentathionate, but he employed solutions a hundred times stronger than those used by Colefax, with the result, not met with by the latter, that he also obtained much sulphur dioxide. His explanation of this evolution of sulphur dioxide is a suggestion of deep theoretical significance, if well founded, with apparently no other explanation possible in place of it. His experiment has no bearing on Colefax's investigation with highly dilute solutions, and Debus's explanation of it is certainly quite inapplicable to the results obtained in other ways, both by himself and by Colefax, as the latter has rightly pointed out in connexion with his own work.

104. "Note on phenolic thetines and their action with benzoyl chloride." By Edward de Barry Barnett and Samuel Smiles.

When phenol and phenetole *p*-sulphoxide are dissolved in concentrated sulphuric acid, *phenoxydiphenetylsulphonium sulphate* is formed. The *platinichloride* of the base is an orange-brown powder melting at

123—125°. The condensation of diphenyl sulphoxide with phenol does not take place in cold sulphuric acid, but it may readily be effected by warming with phosphoric oxide. *Phenoxydiphenylsulphonium platinichloride* occurs in orange crystals, which rapidly decompose at about 210°. The salts of these bases are colourless, viscous oils. On treatment with aqueous alkali hydroxide, they yield the phenolic thetines. These are unstable, yellow oils, which are soluble in water or chloroform and insoluble in concentrated aqueous alkali hydroxide. They are formed (by elimination of alkali salt) from the sodium salt of the sulphonium base,

$$(C_6H_5)_2(C_6H_4\cdot ONa)SCl = NaCl + (C_6H_5)_2{:}\underline{S\cdot C_6H_4\cdot O}.$$

With benzoyl chloride in aqueous alkaline solution, the phenolic thetines yield benzoic anhydride, and in this respect they resemble certain tertiary nitrogen bases, for example, pyridine (Minunni, *Gazzetta*, 1892, **22**, 215). With hydrochloric acid they furnish the chlorides of the corresponding sulphonium bases.

105. "The relation between dielectric constant and chemical constitution. Part I. Stereoisomeric compounds." By Alfred Walter Stewart.

The author has examined active and racemic compounds and also geometrical isomerides, and finds that the influence of the spacial arrangement of atoms on the dielectric constants of isomeric substances is not clearly marked. A difference in electric absorption was noticed in one case, the active isomeride having a stronger absorptive power than the racemic form.

106. "An apparatus for determining the specific inductive capacity of organic liquids." By Alfred Walter Stewart.

In this apparatus, Hertzian waves are generated and conducted along a secondary circuit in the usual manner. The secondary circuit is led through a vertical graduated tube, and an adjustable bridge between the wires of the circuit is obtained by moving mercury up and down within the tube. The apparatus is calibrated in the usual way, by means of liquids of known specific inductive capacity. The chief advantages over the previous method (Drude, *Zeitsch. physikal. Chem.*, 1897, **23**, 267) lie in the regulation of temperature by jacketing the tube (which could not be done easily in the Drude apparatus), in the sharpness of contact between the mercury and the wires of the secondary circuit, and in the comparatively small quantity of substance required for the new apparatus. Reduced pressures can also be used.

107. "The influence of solvents on the rotation of optically active compounds. Part XII. Ethyl tartrate in aromatic halogen derivatives." By Thomas Stewart Patterson and David Paterson McDonald.

The rotation of ethyl tartrate has been examined in chlorobenzene, bromobenzene, iodobenzene, *p*-dichlorobenzene, and *a*-bromonaphthalene. The data were compared with others formerly obtained for benzene and for various aliphatic halogen derivatives. The relationship between rotation and molecular solution-volume in these solvents was discussed, as was also the influence of temperature change on the rotation of dilute solutions of ethyl tartrate in *a*-bromonaphthalene.

108. "A new test for silver." By Arnold William Gregory.

When a solution of a silver salt is added to a mixture of 20 c.c. of aqueous ammonium salicylate (20 grams of salicylic acid neutralised with ammonium hydroxide, a slight excess of the latter added, and the solution made up to 1 litre) and 20 c.c. of ammonium persulphate solution (50 grams in 1 litre), an intense brown colour is produced. By this reaction, 0·01 milligram of silver can be detected. As lead does not give this reaction, silver may be tested for in presence of this element; 1·1 milligram of silver may be detected in this manner in the presence of 0·2 gram of lead.

It was found that the brown substance formed in this reaction does not contain silver, and it is probable that the silver salt acts as a catalyst, since on boiling a solution of ammonium salicylate with ammonium persulphate a similar brown colour is produced.

109. "The spontaneous crystallisation of substances which form a continuous series of mixed crystals: mixtures of naphthalene and *β*-naphthol." By Henry Alexander Miers and Florence Isaac.

The object of this research was tc ascertain whether there are definite temperatures of spontaneous crystallisation in mixtures which yield a continuous series of mixed crystals.

By means of experiments on mixtures of naphthalene and *β*-naphthol of known composition contained in sealed tubes, the authors have determined the supersolubility curve, and also the freezing-point curve and the melting-point curve for the whole series of mixtures.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 8th June, 1908.

All persons who received grants in June, 1907, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Monday, 1st June.

The Council wish to draw special attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal-tar and allied industries.

At the next Ordinary Meeting, **Thursday,** May **21st,** 1908, at **8.30** p.m., the following papers will be communicated:

"Hydroaromatic ketones. Preliminary note." By A. W. Crossley and C. Gilling.

"Titani-dihydroxymaleic acid and the detection of titanium." By H. J. H. Fenton.

"Some experiments on carbon at high temperatures and pressures and apparatus therefor." By R. Threlfall.

"The sulphides and oxysulphides of silicon." By I. G. Rankin and S. M. Revington.

RICHARD CLAY AND SONS, LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/5/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 342

Thursday, May 21st, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Messrs. G. Barr, C. Gilling, G. R. Lynch, W. E. Oakden, D. R. Pinnock, and W. H. Withey were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

William Henry Ballantyne, B.Sc., 99, Holmdene Avenue, Herne Hill, S.E.
Edward Morris Bevan, 10, Coronation Street, Aberkenfig, Glam.
James Brown, 20, Tower Road, Dartford, Kent.
James Hill Fairweather, 62, Wythes Road, Silvertown, E.
Frank William Crossley-Holland, Connaught Club, Marble Arch, W.
Alfred Ash Meggitt, B.Sc., Dacca, Eastern Bengal, India.
Clement Thomas Rutter, 4, Bath Terrace, Hanwell, W.
James Edward Southcombe, M.Sc., 138, Chester Street, Birkenhead, Cheshire.
Edward Stokes, B.A., King William's College, Isle of Man.
Harry James Yates, Redcroft, Four Oaks, Warwickshire.

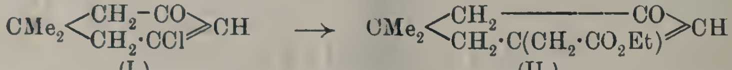
A certificate has been authorised by the Council under Bye-Law I (par. 3) in favour of Hari Prasad Vidyaut, Etawah, U.P., India.

Of the following papers, those marked * were read :—

*110. “Hydroaromatic ketones.” (Preliminary note.)

By Arthur William Crossley and Charles Gilling.

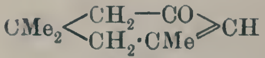
5-Chloro-1 : 1-dimethyl-Δ^4-*cyclo*hexenone-3 (I) reacts readily with ethyl malonate in presence of sodium ethoxide to give *ethyl* 1 : 1-*dimethyl*-Δ^4-cyclo*hexen-3-one-5-acetate* (II). During the condensation,



$$CMe_2{<}\begin{matrix}CH_2-CO\\CH_2\cdot CCl\end{matrix}{\geqslant}CH \longrightarrow CMe_2{<}\begin{matrix}CH_2 \text{———————} CO\\CH_2\cdot C(CH_2\cdot CO_2Et)\end{matrix}{\geqslant}CH$$

(I.) (II.)

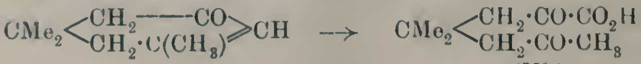
one of the carbethoxy-groups of the ethyl malonate is evidently hydrolysed by the sodium ethoxide, and the resulting carboxyl group loses the elements of carbon dioxide (compare Moore, *Trans.*, 1904, **85**, 165).



$$CMe_2{<}\begin{matrix}CH_2-CO\\CH_2\cdot CMe\end{matrix}{\geqslant}CH$$

(III.)

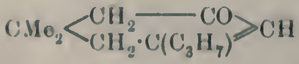
The ester is a faintly yellow oil, boiling at 171°/22 mm. and possessing a slight ethereal odour. It gives a *semicarbazone* melting at 156—157° without decomposition. When hydrolysed with alcoholic potassium hydroxide, the corresponding acid cannot be isolated, as it at once loses carbon dioxide to give 1 : 1 : 5-*trimethyl*-Δ^4-cyclo*hexenone*-3 (III) as a colourless, highly refractive liquid, boiling at 108°/35 mm. and possessing a slight camphoraceous odour. The *semicarbazone* crystallises from alcohol in clusters of flattened needles melting at 190—191°, and the *oxime* forms large, transparent prisms melting at 78°. When oxidised with potassium permanganate, a variety of products are obtained, according to the conditions employed. One acid, melting at 98°, has been proved to have the composition $C_9H_{14}O_4$, and its constitution is most probably represented by formula IV :



$$CMe_2{<}\begin{matrix}CH_2 \text{————} CO\\CH_2\cdot C(CH_3)\end{matrix}{\geqslant}CH \longrightarrow CMe_2{<}\begin{matrix}CH_2\cdot CO\cdot CO_2H\\CH_2\cdot CO\cdot CH_3\end{matrix}$$

(IV.)

The reaction appears to be a general one, for 5-chloro-1 : 1-dimethyl-Δ^4-*cyclo*hexenone-3 condenses with ethyl ethylmalonate in presence of sodium ethoxide, and the product on hydrolysis yields 1 : 1-*dimethyl-5-propyl*-Δ^4-cyclo*hexenone*-3, boiling at 125°/19 mm. and possessing an odour of celery and camphor. The *semicarbazone* crystallises from alcohol in rosettes of flattened needles melting at 156°. The work is being extended, and the products and by-products of the various reactions are under closer investigation.



$$CMe_2{<}\begin{matrix}CH_2 \text{————} CO\\CH_2\cdot C(C_3H_7)\end{matrix}{\geqslant}CH$$

*111. "The sulphides and oxysulphides of silicon." By Irvine Giles Rankin and Sidney Montagu Revington.

The white sulphide of silicon, first prepared by Berzelius, has been shown definitely to be the disulphide, SiS_2. The orange sulphide, SiS, prepared by Colson, has been investigated, and, in addition, the composition of two sulphoxides, SiSO and $SiSO_2$, has been determined; the former is mentioned by Colson, but was not analysed by him, whilst the latter has been hitherto unknown.

Discussion.

The President congratulated Mr. Revington and Mr. Rankin on the results they had obtained. He could testify to their perseverance, and, although the analyses which they had quoted were not so concordant as is usual, the difficulties of separating and obtaining in a pure state three such bodies as SiS_2, SiOS, and SiS were great, and at present, at all events, we had to be content with what were great improvements on former results.

*112. "Apparatus for experiments at high temperatures and pressures and its application to the study of carbon." By Richard Threlfall.

The author described a small and inexpensive laboratory apparatus for exposing carbon or other substances to very high temperatures and pressures. It was shown how small quantities of material may be heated up to the temperature of the melting point of magnesia at pressures up to 100 tons per square inch. These results are rendered possible by taking advantage of the practically perfect fluidity of crystalline graphite under high pressures. Instead of using compressed gases, as has hitherto been done in order to obtain high pressures, it is only necessary to make use of crystalline graphite, which is, of course, very much more easily and safely handled. The graphite itself acts as a conductor whereby electric heating is rendered possible.

Some experiments on heating graphite or amorphous carbon up to the melting point of magnesia at pressures up to 100 tons per square inch were described. In no case was anything produced but soft, crystalline graphite, the results obtained agreeing precisely with those already published by Parsons (*Proc. Roy. Soc.*, 1907, **79**, *A*, 532).

A summary was given of our present information in regard to the transformation of carbon, and the view is taken that the formation of diamond under certain conditions is not so much a direct transformation of carbon as the result of the liberation of carbon by decomposition of carbides in presence of certain substances which induce it to crystallise in any of the well-known forms of diamond. These substances can be recognised by a study of the ash left when diamonds are burnt. The only condition as to temperature is that it must be low enough for the velocity of transformation into graphite to be small. The results obtained by Hasslinger and others were examined from this point of view.

*113. "Acids as accelerators in the acetylation of amino-groups." By Alice Emily Smith and Kennedy Joseph Previté Orton.

When the basic properties of amino-groups are in abeyance, acids act as powerful accelerators of acetylation by means of acetic anhydride. Such amino-groups are present in anilines with two negative groups in the ortho-positions with respect to the amino-group.

All strong acids, very small quantities of which are alone needed, act in this manner. Sulphuric, hydrochloric, perchloric, trichloroacetic, nitric, and chromic acids have been tested; the two latter behave exceptionally, yielding respectively nitroaminobenzene, $Ar\cdot NH\cdot NO_2$, and products of oxidation of the aniline.

The formation of diacetyl as well as of monoacetyl derivatives of the anilines, is aided by the presence of acids.

In the case of basic amino-groups, the reaction of which with acetic anhydride, even when largely diluted by a neutral solvent, is extremely rapid, acids act as mild inhibitors of acetylation.

Details of the preparation of typical mono- and di-acetanilides with the aid of strong acids were described.

*114. "The chemical action of radium emanation. Part III. On water and certain gases." By Alexander Thomas Cameron and Sir William Ramsay, K.C.B.

The decomposition of water and the recombination of hydrogen and oxygen, when treated with radium emanation, have been confirmed by numerous experiments. Carbon dioxide is decomposed into carbon, oxygen, and the monoxide. The last named gives carbon, oxygen, and the dioxide. Ammonia breaks up into its components. These recombine, but in smaller quantity for the same amount of emanation. Hydrogen chloride is decomposed into hydrogen and chlorine. At 130°, hydrogen and oxygen recombine during five hours at a steady rate; steam is apparently undecomposed. The time rates of the various reactions were measured; the volume was kept constant, and change of pressure indicated the rate of change. This was in all cases proportional to the rate of change of the emanation. In other words, it obeyed the same exponential law; the amount of change in any time was strictly proportional to the amount of emanation disintegrating in that time. Hence, other conditions being the same, each atom of emanation, as it disintegrates, produces a certain definite chemical effect.

*115. "The chemical action of radium emanation. Part IV. On water." By Alexander Thomas Cameron and Sir William Ramsay, K.C.B.

The results obtained in a previous experiment (*Trans.*, 1907, **91**, 1593) have been confirmed; radium emanation in presence of water breaks up into neon. The neon was conclusively identified by its spectrum; the lines were almost as bright as those of the helium visible at the same time. The spectrum was photographed successfully, and a large number of the neon lines identified. It faded rapidly; the neon lines practically disappeared in ten minutes.

116. "Titani-dihydroxymaleic acid and the detection of titanium." By Henry John Horstman Fenton.

Dihydroxymaleic acid reacts in cold dilute aqueous solution with quadrivalent titanium compounds, giving an intensely reddish-brown solution. The reaction is so sensitive that it serves for the detection of minute traces of titanium. It is very much more delicate than the hydrogen dioxide test, and has the additional advantage that it is not given by vanadium.

From more concentrated solutions, a voluminous chocolate-coloured precipitate separates, which has the empirical composition

$$C_4H_4O_6,2TiO_2,2\tfrac{1}{2}H_2O.$$

This compound acts as an acid, giving, when treated with alkalis bright orange-coloured salts.

Compounds having a similar composition have previously been obtained with many other aliphatic acids, but they are all colourless.

The coloured compound obtained with dihydroxymaleic acid is at once destroyed by hydrofluoric acid or soluble fluorides, and may, as in the case of the hydrogen dioxide reaction, be employed for the detection of fluorides. Owing to the marked difference in colour between the acid and its salts, the compound may also be used as an alkali-acid indicator.

117. "The preparation of diselenides. Dibenzyl diselenide." (Preliminary note.) By Thomas Slater Price and Lionel Manfred Jones.

The method employed by Price and Twiss (*Trans.*, 1907, **91**, 2021) for the preparation of disulphides has been extended to the preparation of diselenides. A solution of sodium selenosulphate was obtained by digesting excess of selenium with a solution of sodium sulphite and then filtering. On adding this solution to an alcoholic solution of benzyl chloride, a turbid liquid was obtained, which, however, soon cleared when heated on a water-bath under reflux. After a short time, sulphur dioxide was evolved, and a small quantity of a yellow oil separated, which, after removal from the remainder of the liquid, solidified on cooling; on recrystallisation from alcohol, it was obtained in lustrous, yellow crystals, melting at 90·5°, and had all the characteristic properties of dibenzyl diselenide, as described by Jackson (*Annalen*, 1875, **179**, 1). It had probably been formed according to the following equations, the evidence for which the authors hope to publish later:

$$C_6H_5{\cdot}CH_2Cl + Na_2SeSO_3 = C_6H_5{\cdot}CH_2{\cdot}Se{\cdot}SO_3Na + NaCl.$$
$$2C_6H_5{\cdot}CH_2{\cdot}Se{\cdot}SO_3Na + H_2O = (C_6H_5{\cdot}CH_2{\cdot}Se)_2 + Na_2SO_4 + H_2O + SO_2.$$

On allowing the mother liquor to stand, a further quantity of diselenide slowly separated, sulphur dioxide being continuously evolved. The diselenide was also obtained from the mother liquor, after the addition of potassium hydrogen carbonate, by electrolysis in a divided cell, the method being similar to that used in the preparation of disulphides (Price and Twiss, *loc. cit.*).

118. "The optical and sensitising properties of the *iso*cyanine dyes." By Samuel Edward Sheppard.

The absorption spectre and sensitising power for gelatino-bromide plates have been investigated for a series of dyes of the *iso*cyanine group. It was shown that solutions in alcohol and chloroform conform to Beer's law, and that the colour is probably independent of ionisation. Further, in different solvents, the absorption follows Kundt's rule, the bands being shifted to the red as the dispersive power of the solvent increases. The influence of different substituted groups on the absorption and sensitising power was measured. It is found that for a group of dyes of similar chemical constitution the photochemical activity is proportional to the rate of fading in light. Comparison of the sensitising and absorption spectra shows that the bands in the latter are regularly displaced to the red some 10 $\mu\mu$, as would be expected from their behaviour in different solvents. The investigation of the conditions of sensitising by bathing shows that the "taking-up" of the dye is an absorption process comparable with substantive dyeing.

119. "The polarimetric study of intramolecular rearrangement in inactive substances." By Thomas Stewart Patterson and Andrew McMillan.

Continuing previous work (*Trans.*, 1907, **91**, 504; *Ber.*, 1907, **40**, 2564), the authors have applied their new method for studying intramolecular rearrangement in inactive compounds to measure the rate of inversion of piperonal*syn*oxime at a number of temperatures. The increase of velocity with rise of temperature was found to obey van't Hoff's law. The method was also applied for the measurement of the inversion of *p*-iodobenz*syn*aldoxime in *n*-propyl tartrate and to the transformation of ω-*iso*nitrotoluene into ω-nitrotoluene, satisfactory constants being obtained. It was shown that by the same method the dynamic isomerism of ammonium thiocyanate and thiocarbamide and of ammonium cyanate and carbamide could be followed.

120. "Mercuric zinc cyanide." A correction.
By Wyndham Rowland Dunstan.

In a paper communicated to the Society in 1892 (*Trans.*, 1892, **61**, 666), the author described the results of an investigation of the "antiseptic cyanide" which had been introduced into surgery by Lord Lister. The conclusion was arrived at that the substance was an unstable double mercuric zinc cyanide, for which the formula proposed was $Zn_4Hg(CN)_{10}$, and this was stated to correspond with 40·65 per cent. of mercuric cyanide. This is a miscalculation, as the formula actually requires 35 per cent. of mercuric cyanide, and must therefore be rejected.

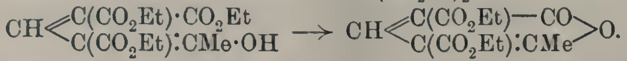
The formula which most nearly corresponds with the maximum percentage of mercuric cyanide found, namely, 38·5, and which is also in accordance with the curves plotted from numerous experimental data, is $Zn(CN)_2,\frac{1}{3}Hg(CN)_2$, which requires 41·6 per cent. of mercuric cyanide.

The salt, prepared as described, may therefore be regarded as a trizincic monomercuric octacyanide of the formula $Zn_3Hg(CN)_8$, which, as shown, inevitably suffers some decomposition by the water present during its precipitation.

121. "Ethyl 6-methyl-2-pyrone-3 : 5-dicarboxylate and its derivatives." By John Lionel Simonsen.

When ethyl ethoxymethylenemalonate reacts with ethyl sodioacetoacetate, *ethyl* 6-*methyl*-2-*pyrone*-3 : 5-*dicarboxylate* is obtained :

$$\mathrm{(CO_2Et)_2{:}C{:}CH\cdot OEt + CHNaAc\cdot CO_2Et} \longrightarrow \mathrm{(CO_2Et)_2\cdot C{:}CH\cdot CHAc\cdot CO_2Et}.$$



$$\mathrm{CH}{<}\begin{matrix}\mathrm{C(CO_2Et)\cdot CO_2Et}\\ \mathrm{C(CO_2Et){:}CMe\cdot OH}\end{matrix} \longrightarrow \mathrm{CH}{<}\begin{matrix}\mathrm{C(CO_2Et)-CO}\\ \mathrm{C(CO_2Et){:}CMe}\end{matrix}{>}\mathrm{O}.$$

The same product results from the interaction of (I) ethyl ethoxymethyleneacetoacetate and ethyl sodiomalonate; (II) ethyl ethoxymethyleneacetoacetate and the ethyl sodiocyanoacetate, and (III) ethyl ethoxymethylenecyanoacetate and ethyl sodioacetoacetate.

Ethyl 6-methyl-2-pyrone-3 : 5-dicarboxylate readily reacts with ammonia, with formation of *ethyl ammonium* 6-*hydroxy*-2-*methylpyridine*-3 : 5-*dicarboxylate*, $\mathrm{CH}{<}\begin{matrix}\mathrm{C(CO_2\cdot NH_4)\cdot C(OH)}\\ \mathrm{C(CO_2Et) = CMe}\end{matrix}{>}\mathrm{N}$, which on hydrolysis with alcoholic potash yields 6-hydroxy-2-methylpyridine-3 : 5-dicarboxylic acid, $\mathrm{CH}{<}\begin{matrix}\mathrm{C(CO_2H)\cdot C(OH)}\\ \mathrm{C(CO_2H)=CMe}\end{matrix}{>}\mathrm{N}$, which has already been described by Errera (*Ber.*, 1900, **33**, 2969). The action of aniline on ethyl 6-methyl-2-pyrone-3 : 5-dicarboxylate has also been investigated.

122. "Contributions to the chemistry of the amidines. Part II. 2-Anilinobenzoxazole and the supposed anilodihydrobenzoxazole." By George Young and Albert Edward Dunstan.

The authors have reinvestigated the two substances described in the literature as anilinobenzoxazole and anilodihydrobenzoxazole. They confirm the nature and constitution of the anilino-compound, but find that the supposed isomeride is in reality carbanilide.

The following substances were described :

Acetylanilinobenzoxazole, $\mathrm{C_{13}H_9ON_2Ac}$, m. p. 91°, p-*chlorophenylcarbamide*, $\mathrm{C_7H_7ON_2Cl}$, m. p. 212°, di-*p*-chlorocarbanilide, m. p. 289°, *trichlorocarbanilide*, $\mathrm{C_{13}H_9ON_2Cl_3}$, m. p. 262°, and di-*p*-tolylcarbamide, m. p. 265°.

123. "The slow decomposition of ammonium chromate, dichromate, and trichromate by heat." By Walter Craven Ball.

When ammonium dichromate is heated at temperatures between 185° and 205°, it gradually becomes dark brown and finally black, and nitrogen, water, and ammonia are evolved. After heating for several days, the remaining black substance has the approximate percentage composition: Cr_2O_3, 83·89; active oxygen, 9·00, and water, 6·93. This corresponds fairly well with the formula $3CrO_2,H_2O$, but the composition is not quite constant.

If the heating is interrupted at an intermediate stage, it is found that part of the dichromate has decomposed, with production of a black, insoluble substance, nearly half the nitrogen of the decomposed dichromate being contained in it. This black substance also varies in composition, but approximates to the formula $2CrO_3,Cr_2O_3,2NH_3,H_2O$.

The slow decomposition of ammonium dichromate is therefore partly a dehydration to this insoluble compound containing ammonia, and partly a combustion of the hydrogen of the ammonium to form water, with production of nitrogen.

The author has studied quantitatively the decomposition of ammonium chromate and of ammonium trichromate under similar conditions; the substances decompose in a similar manner.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bloxam, *W. Popplewell.* Report to the Government of India, containing an account of the research work on indigo performed in the University of Leeds, 1905—1907, by *W. Popplewell* **Bloxam**, with the assistance of *S. H.* **Wood**, *I. Q.* **Orchardson**, *R.* **Gaunt**, and *F.* **Thomas**; and under the general supervision of *A. G.* **Perkin**. pp. 117. 1908. (*Recd.* 19/5/08.) From His Majesty's Secretary of State for India.

Institute of Chemistry of Great Britain and Ireland. A list of official chemical appointments compiled, . . . by *Richard B.* **Pilcher**. Second edition. pp. 172. London 1908. (*Reference.*)

From the Institute of Chemistry.

Landauer, *John.* Spectrum analysis. Authorised English translation by *J. Bishop* **Tingle**. Second edition. pp. ix + 236. New York 1907. (*Recd.* 13/5/08.)

From the Publishers: Messrs. John Wiley & Sons.

National Physical Laboratory. Collected researches. Vols. II. and III. pp. 286, 252. ill. [London] 1908. (*Recd.* 16/5/08.)

——— Report for the year 1907. pp. 97. ill. Teddington 1908.

From the National Physical Laboratory.

Richardson, *S. S.* Magnetism and electricity, and the principles of electrical measurement. pp. viii + 596. ill. London 1908. (*Recd.* 14/5/08.) From the Publishers: Messrs. Blackie & Son.

United States. *Public Health and Marine-Hospital Service. Hygienic Laboratory.* Bulletin No. 41. Milk in its relation to the public health. By various authors. pp. 756. ill. Washington 1908. (*Recd.* 4/5/08.) From the Surgeon-General.

II. *By Purchase.*

Brouchuisius, *Daniel.* Secreta Alchimiæ Magnalia D. Thomæ Aquinatis, De Corporibus supercœlestibus, & quòd in rebus inferioribus inveniantur, quoq̃ue modo extrahantur: De Lapide minerali, animali, & plantali. Item Thesaurus Alchimiæ secretissimus; quem dedit frati suo Reinaldo. Accessit et Ioannis De Rupescissa Liber lucis, ac Raymundi Lullij opus pulcherrimum, quod inscribitur Clavicula & Apertorum in quo omnia quæ in opere Alchimiæ requiruntur, venustè declarantur, & sine quo, ut ipse testatur Lullius, alij sui Libri intelligi neqeunt. Opuscula studiosis artis secretissimæ, ut summè necessaria, ita lectu iucundissima . . . Cum Præfatione D. Ioannis Heurnij. Lugduni Batavorum, Ex Officinâ Thomæ Basson 1598. pp. 71. 1 plate. (*Reference.*)

Carrara, *G.* Elektrochemie der nichtwässrigen Lösungen. Uebersetzt von *Kurt* **Arndt.** (Sammlung, Vol. XII.) Stuttgart 1908. (*Recd.* 27/4/08.)

Congrès international de chimie appliquée. Bruxelles-Anvers, 4-11 Août 1894. Compte rendu. pp. ccxxxi + 302. Bruxelles 1894. (*Recd.* 14/5/08.)

——— Paris. Compte rendu in-extenso. 3 vols. pp. 622, 788, 472. Paris 1902. (*Recd.* 14/5/08.)

Hjelt, *Edv.* Berzelius-Liebig-Dumas. Ihre Stellung zur Radikaltheorie 1832—1840. (Sammlung, Vol. XII.) Stuttgart 1908. (*Recd.* 27/4/08.)

Hofmann, *A. W.* Biographie de Jean Baptiste André Dumas, avec complément. pp. 74, 14. Paris 1880, 1885. (*Recd.* 14/5/08.)

Mynsicht, *Hadrianus* **à.** Thesaurus et Armamentarium Medico-Chymicum. In quo selectissimorum contra quosuis morbos Pharmacorum conficiendorum secretissima ratio aperitur, unà cum eorundem Virtute, Usu, & Dosi. Cui in fine adjunctum est Testamentum Hadrianeum de Aureo Philosophorum lapide. Editio tertia emendatior. Venetiis, 1696. pp. [xvi] + 490 + [xlii]. (*Reference.*)

Ruer, *Rudolf.* Metallographie in elementarer Darstellung. pp. xii + 312. ill. Hamburg 1907. (*Recd.* 20/5/08.)

Ubbelohde, *L.* Handbuch der Chemie und Technologie der Oele und Fette. Chemie, Analyse, Gewinnung und Verarbeitung der Oele, Fette, Wachse und Harze. Band I. pp. xiv + 832. ill. Leipzig 1908. (*Recd.* 20/5/08.)

Vorländer, *D.* Kristallinisch-flüssige Substanzen. (Sammlung, Vol. XII.) Stuttgart 1908. (*Recd.* 30/3/08.)

Watts, *W. Marshall.* Index of spectra. Appendix S. pp. 155. London 1908. (*Recd.* 14/5/08.)

Zeitschrift für wissenschaftliche Photographie Photophysik und-Photochemie. Vol. VI, &c. Edited by *K.* **Schaum.** Leipzig 1908 + . (*Reference.*)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, 8th June, 1908.

All persons who received grants in June, 1907, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Monday, 1st June.

The Council wish to draw special attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal-tar and allied industries.

At the next Ordinary Meeting, **Thursday**, June **4**th, 1908, at **8.30** p.m., the following papers will be communicated:

"Condensation products from pinene aminodicarboxylic acid." By W. Godden.

"A delicate test for bromides alone, or in solution with chlorides." By J. S. Jamieson.

"Experiments on the synthesis of 1-methyl*cyclo*hexylidene-4-acetic acid." By W. H. Perkin and W. J. Pope.

"The triazo-group. Part IV. Allylazoimide." By M. O. Forster and H. E. Fierz.

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Issued 16/6/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. **No. 343**

Thursday, June 4th, 1908, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Mr. J. Gibson was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Thomas Aubertin, B.A., c/o Messrs. George Anderson & Co., Ltd., Carnoustie, N.B.
John William Pearson, B.A., Buxton College, Buxton.
Frank Perry, 63, Tunnel Street, Coseley, near Bilston, Staffs.
George O'Brien Power, Fatehpur, U.P. of Agra & Oudh, India.
William Frothingham Roach, M.D., M.S., Royal Mersey Yacht Club, Rock Ferry, Cheshire.

Of the following papers, those marked * were read :—

***124. "The interaction of copper and nitric acid in presence of metallic nitrates considered with reference to the existence of hydrates in solution." By Edward Henry Rennie, Alfred James Higgin, and William Tennant Cooke.**

The authors find that in most cases the addition of metallic nitrates greatly accelerates the dissolution of copper in nitric acid, but that nitrates, such as those of rubidium and cæsium, cause considerable retardation. They consider that these effects are due to the withdrawal by the salts of water or nitric acid from the solution, and the consequent concentration or dilution of the acid, and regard their results as confirmatory of the views now generally held that combination takes place between solvent and solute. They find, moreover, that the accelerations produced by the nitrates of any one group of metals decrease as the atomic weights of the metals increase. When copper nitrate is added to the nitric acid, the dissolution is greatly accelerated. Hence the view that the auto-acceleration always observed when copper is dissolved in nitric acid is due to nitrous acid requires to be modified, the accumulation of copper nitrate in the solution being an important factor in the progress of the change.

DISCUSSION.

Dr. VELEY remarked that the results obtained by the authors might in some cases be due, not to the nitrates *per se*, but also to the nitrous acid or nitrites formed therefrom. Thus, when the conditions are such that copper dissolves in nitric acid (containing nitrous acid), copper nitrite is initially formed, which is subsequently converted into the nitrate. It appeared to him that it would be of interest if the authors were to extend their investigations to metals other than copper, such as mercury, which dissolves initially as mercurous nitrite, yielding mercurous nitrate and, finally, mercuric nitrate under certain conditions. Silver and bismuth behave generally as copper.

Mr. W. C. REYNOLDS pointed out that nitric acid, with or without the presence of nitrates, has no action whatever on metallic copper if it is freed from traces of nitrous acid, even in the case of much stronger acid than that referred to. This could be effected in a few seconds at the ordinary temperature by adding a trace of sodium peroxide to the acid solution—the addition of carbamide was not so effective.

The alkaloids, morphine, and especially brucine, afford colour tests for the presence of nitrous acid in such acid solutions, and the addition of either should cause no coloration for some hours in the absence of nitrous acid (Reynolds and Sutcliffe, *J. Soc. Chem. Ind.*, 1906, **25**, 512). He thought some of the apparently anomalous results obtained by the authors might be due to the varying amount of the "trace" present.

Prof. ARMSTRONG (who had given an account of the paper) said that, whilst he was in accord with the authors that salts exercised a "concentrating effect," he did not think that the acceleration observed was due to the direct withdrawal of water from the nitric acid; the acid used was too dilute and the proportion of salt too small to account, on such an assumption, for the effects produced. It was, however, well known that the dissolution of copper was dependent on the presence of nitrous compounds, and he was inclined to think that salts produced their effect by modifying the condition of these compounds in solution. From this point of view, the observations were most striking and valuable as throwing fresh light on the changes involved in the dissolution of metals in presence of nitric acid.

As to the influence of copper nitrate, it was to be remembered that the heat of dissolution of copper in nitric acid is a negative quantity, and that, from this point of view, copper nitrate is a more effective solvent of copper than the acid.

*125. "The triazo-group. Part IV. Allylazoimide."

By Martin Onslow Forster and Hans Eduard Fierz.

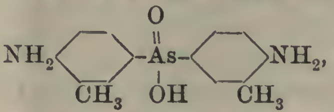
Allylazoimide, $CH_2:CH\cdot CH_2\cdot N_3$, prepared with some difficulty from allyl chloride and sodium azide, is a mobile, refractive liquid which boils at 76·5° under 760 mm. pressure; owing to subsidiary changes, the yield is disappointing. The *dibromide*, $C_3H_5N_3Br_2$, is a heavy, colourless liquid, boiling at 87° under 5 mm. pressure.

The diazoamino-*compound*, $C_3H_5N_3$, arises from allylazoimide by spontaneous isomeric change, crystallising from the liquid azoimide in colourless, transparent, lustrous prisms which melt and decompose at 192°; the substance is bimolecular, and is remarkably sensitive towards dilute acids, including acetic, which liberate two-thirds of the nitrogen in elemental form.

*126. "Aromatic arsonic and arsinic acids."

By Frank Lee Pyman and William Colebrook Reynolds.

In the preparation of *p*-aminophenylarsonic acid and 2-aminotolyl-5-arsonic acid, the corresponding bisaminoarylarsinic acids, which have been briefly alluded to by Benda and Kahn (*Ber.*, 1908, **41**, 1672), were obtained. The isolation of these by-products was described, and the following new substances were characterised.

Bis-2-aminotolyl-5-arsinic acid,  forms highly refracting, microscopic needles, melting and decomposing at 247—249°. The *sodium* salt forms large, hard, prismatic needles, which melt at 74—75° and contain $7\frac{1}{2}$ molecular proportions of water of crystallisation.

Bis-2-acetylaminotolyl-5-arsinic acid, $C_{18}H_{21}O_4N_2As,\frac{2}{3}H_2O$, crystallises from water in highly refracting, microscopic prisms, melting at 242—244°.

Its *sodium* salt forms radial clusters of silky needles, which melt at 106—107° and contain 6 molecules of water of crystallisation.

Bis-p-*aminophenylarsinic acid*, $C_{12}H_{13}O_2N_2As$, forms matted needles, melting at 248—249°. Its *sodium* salt crystallises in large, monoclinic plates, containing between 5 and 6 molecular proportions of water of crystallisation; its *barium* salt forms large, hard prisms containing 7½ molecular proportions of water of crystallisation.

Bis-p-*acetylaminophenylarsinic acid*, $C_{16}H_{17}O_4N_2As,3H_2O$, crystallises from water in rosettes of needles, and melts at 275°. Its *sodium* salt forms prismatic needles containing 9 molecules of water of crystallisation.

Discussion.

The President inquired whether, in view of the fact that antimony compounds appeared to be more effective than arsenic compounds as a remedy for sleeping sickness, any attempts had been successful to form similar compounds with antimonic acid?

Dr. Pyman replied that no such attempts had as yet proved successful.

127. "Condensation products from aminopinenedicarboxylic acid." By William Godden.

Condensation products of glycine and aspartic acid with aminopinenedicarboxylic acid have been obtained, and their copper salts prepared.

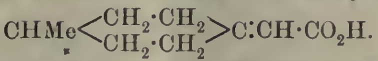
128. "A delicate test for bromides alone or in solution with chlorides." By James Sprunt Jamieson.

The solution to be tested is heated to boiling with 1 or 2 c.c. of dilute sulphuric acid and 1 or 2 c.c. of potassium dichromate; it is then cooled, and shaken with chloroform. The chloroform layer is separated, washed two or three times with water, and finally shaken with a little dilute potassium iodide solution. In the presence of a bromide, the chloroform is coloured violet, due to the liberated iodine.

The following equation probably represents the reaction:

$$6NaBr + K_2Cr_2O_7 + 7H_2SO_4 = 3Na_2SO_4 + K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3Br_2.$$

The above reaction will detect 0·5 milligram of sodium or potassium bromide, either free or in presence of sodium chloride.

129. "Experiments on the synthesis of 1-methyl*cyclo*hexylidene-4-acetic acid,  $CHMe<\substack{CH_2\cdot CH_2\\CH_2\cdot CH_2}>C:CH\cdot CO_2H$. Part I." By William Henry Perkin, jun., and William Jackson Pope.

The authors have continued the work of which a preliminary account has already appeared (*Proc.*, 1906, **22**, 107).

130. "A method for the measurement of rate of change in solid alloys." (Preliminary note.) By Guy Dunstan Bengough.

The method consists in heating portions of the metastable alloy at a selected temperature for various lengths of time. The portions are then quenched in water to stereotype as far as possible the phases present at the selected temperature. Photomicrographs are made at a magnification determined by the coarseness of the crystalline structure. From the entire negative, an enlargement is made on bromide paper, the degree of enlargement again depending on the coarseness of the structure. The relative proportions of the phases present may then be determined by cutting them out separately and weighing. Curves are then plotted with axes representing time and percentages of any given constituent, showing the rate of change at the selected temperature.

Tests made on the uniformity of the bromide paper used for the enlargement and on the difference in weight between portions of the paper which printed black and white respectively have shown that the errors due to these causes are negligibly small when compared with some others inherent in the process.

Duplicate measurements of the percentage of one of the constituents in a copper-zinc alloy gave the following results:

Alloy.	Proportion of α-constituent.	Mean.
Cu, 60 per cent. Zn, 40 ,, ...	i. 67·3 ii. 67·7	67·5
Another specimen of same alloy	i. 67·5 ii. 67·7	67·6
Another specimen annealed 7 hours at 540° and slowly cooled	i. 89·2 ii. 89·3	89·25

By careful selection of typical portions of the alloy, and with crystalline structures suitable to the method, the limit of accuracy appears to be about ± 0·25 per cent.

Comparative tests have been made to ascertain how far planimetric measurements of the areas of the phases after enlargement agree with the results obtained by the method described:

Alloy.	Proportion of α-constituent.		Mean.
Cu, 60 per cent. Zn, 40 ,,	By planimeter	59·2; 58·5	58·85
	By weighing	59·6; 60·0	59·8
Same, annealed at 640° and slowly cooled	By planimeter	64·6; 64·2	64·4
	By weighing	65·3; 64·6	64·95

The planimeter gives the lower result in both cases, for a reason not yet ascertained. The actual proportions of the α constituent in the above experiments have no significance; they depend on the rate of cooling adopted in the various experiments. The particular alloys used have merely been chosen to test the method of measurement proposed.

Huntington and Desch have very recently (April 28, 1908) read a paper before the Faraday Society on the "Planimetric Analysis of Alloys," and their work has come to the author's notice since his own results were obtained. They consider the planimetric measurement of the areas to be more accurate and preferable to weighing. The present author considers the weighing method to be preferable for many kinds of structure, and to be susceptible of considerable accuracy. The author is using it for the measurement of rate of change in copper-zinc alloys.

131. "Viscosity determinations at high temperatures."

By Charles Edward Fawsitt.

The viscosity of some fused salts and metals has been measured by the method recently described by the author (*Proc. Roy. Soc.*, 1908, **80**, *A*, 290). The absolute viscosities of sodium nitrate, potassium nitrate, sodium chloride, potassium chloride, sodium bromide, potassium bromide, and lithium chloride have been determined over a considerable range of temperature. The best comparison of the viscosities of salts is obtained by choosing in all cases the values at the melting points, or at temperatures equally distant from the melting points. The viscosity of a sodium salt at its melting point is very nearly the same as the viscosity of the corresponding potassium salt. The viscosity of the salts examined was in no case greater than 0·03 (C.G.S. units); as the viscosity of water at 20° is 0·01, the viscosity of these salts is really not so much greater, as might have been expected. The viscosity of a mixture of sodium and potassium nitrates shows a maximum value at the composition corresponding with the eutectic mixture, provided the comparison is made at temperatures equally distant from the melting points. The viscosity of a salt decreases with rise of temperature. The temperature-coefficients of these salts are proportional to their viscosities. Metals have also a small viscosity. Lead and tin at their melting points are only about three times as viscous as water. Bismuth and mercury have only about twice the viscosity of water. When a molten metal is cooled to its solidifying point, there is no abrupt or large increase in the viscosity to indicate the approach of the solid state. The change from the liquid to the solid state corresponds with a sudden and violent change in viscosity.

132. "Dinitrodiphenylamine-*o*-sulphonic acids." (Preliminary note.)

By Samuel Smiles.

By heating 2-chloro-5-nitrobenzenesulphonic acid with the nitroanilines, the corresponding diphenylamine-*o*-sulphonic *acids* are formed. The acids may be isolated as the sparingly soluble, yellow *sodium* salts in a yield equal to about 20—25 per cent. of the theoretical. These substances have been prepared with a view to effecting the synthesis of the diphenylamine sulphoxides.

133. "The study of the absorption spectra of the hydrocarbons isolated from the products of the action of aluminium chloride on naphthalene." By Annie Homer and John Edward Purvis.

In an investigation of the action of aluminium chloride on naphthalene, one of the authors isolated, besides Friedel & Crafts' ββ-dinaphthyl, three new hydrocarbons, $C_{14}H_{16}$, $C_{26}H_{22}$, and $C_{40}H_{26}$ (*Trans.*, 1907, **91**, 1103). In the hope of obtaining additional evidence as to the constitution of these substances, a comparative study of their absorption spectra with that of naphthalene has been made. The absorption spectrum of the hydrocarbon $C_{26}H_{22}$, which was supposed to be an alkyl derivative of dinaphthanthracene, $C_{22}H_{14}$, has also been compared with those of dinaphthanthracene and picene.

The absorption curves for these hydrocarbons show that:

1. The hydrocarbon $C_{14}H_{16}$ is a naphthalene derivative.

2. The hydrocarbon $C_{40}H_{26}$ has a constitution similar to that of ββ-dinaphthyl.

3. The isomeric hydrocarbons, picene, and dinaphthanthracene have markedly different absorption curves.

4. The hydrocarbon $C_{26}H_{22}$ is an alkyl derivative of picene and not of dinaphthanthracene, as had been previously suggested.

134. "The synthesis and constitution of certain pyranol salts related to brazilein and hæmatein." By William Henry Perkin, jun., Robert Robinson, and [in part] Maurice Russell Turner.

The authors have continued the work of which a preliminary account has already appeared (*Proc.*, 1907, **23**, 149).

135. "Brazilin, hæmatoxylin, and their derivatives. Part IX. On Brazilein, hæmatein, and their derivatives." By Paul Engels, William Henry Perkin, jun., and Robert Robinson.

The authors have continued the investigation of which a preliminary account has already appeared (*Proc.*, 1907, **23**, 166, 291).

136. "The effect of constitution on the optical activity of nitrogen compounds." By Reginald William Everatt.

Three substituted ammonium iodides containing the *n*-butyl group, namely, phenylmethyl-*n*-butylallyl, *p*-bromophenylbenzylmethyl-*n*-butyl, and *p*-bromophenylmethyl-*n*-butylallylammonium iodides, and also *p*-bromophenylbenzylmethylallylammonium iodide have been resolved. The first three were required to fill up gaps in the series already examined (Thomas and Jones, *Trans.*, 1906, **89**, 280; Jones and Hill, *Trans.*, 1908, **93**, 295), whilst the fourth was needed for purposes of comparison with the phenylbenzylmethylallylammonium iodide of Pope and Peachey (*Trans.*, 1899, **75**, 1127). The camphorsulphonic acids failed to effect resolution in the case of the third compound mentioned, which was successfully accomplished by means of both camphoric and tartaric acids.

The values obtained for the ammonium salts containing the radicles named are as follows:

	$[M]_D$ for basic ion.	$[M]_D$ for iodide in alcohol.	$[M]_D$ for iodide in chloroform.
Phenylmethyl-*n*-butylallyl	85·6°	105·1°	123·0°
p-Bromophenylmethyl-*n*-butylallyl..	98·0	114·3	187·9
p-Bromophenylbenzylmethyl-*n*-butyl	−308·7	−354·2	−481·5
p-Bromophenylbenzylmethylallyl ...	−191·1	−242·1	−346·0

In all the cases previously examined, the value of $[M]_D$ for the iodide in chloroform is greater than in alcohol; $[M]_D$ for the iodide in alcohol is greater than $[M]_D$ for the ion in water, and the chloroform solution becomes inactive, owing to racemisation.

These relations hold in the above cases, which were, however, peculiar in that the rapidity of racemisation in chloroform was much greater than usual, none of the above compounds requiring more than twenty-four hours, and some considerably less, for complete racemisation.

137. "The electrolytic oxidation of some hydroxybenzoic acids." By Arthur George Perkin and Frederick Mollwo Perkin.

Sodium purpurogallincarboxylate, $C_{11}H_7O_5 \cdot CO_2Na,4H_2O$, obtained by the electrolytic oxidation of gallic acid, forms orange-brown leaflets, and this with potassium acetate gives the *potassium* salt, $C_{11}H_7O_5 \cdot CO_2K,3H_2O$, crystallising in prismatic needles. The *barium* salt, $(C_{12}H_7O_7)_2Ba$, crystallises similarly.

Methyl tetramethylpurpurogallincarboxylate, $C_{12}H_3O_7(CH_3)_5$, forms pale yellow needles, m. p. 120—121°, and on hydrolysis furnishes the *acid*, $C_{12}H_4O_7(CH_3)_4$, yellow needles, m. p. 182—183°. Purpurogallincarboxylic acid by boiling with concentrated potassium hydroxide solution is converted into *purpurogallonecarboxylic acid*, $C_{11}H_7O_5 \cdot CO_2H$, yellow needles melting above 360°, which separate both in the anhydrous form and with two molecules of water. On acetylation, *acetylanhydropurpurogallonecarboxylic acid*, $C_{12}H_4O_6 \cdot (C_2H_3O)_2$, is produced in colourless needles, m. p. 236—238°, which on hydrolysis is reconverted into purpurogallonecarboxylic acid.

Methyl tetramethylpurpurogallonecarboxylate,

$$C_{11}H_3O(O \cdot CH_3)_4 \cdot CO_2 \cdot CH_3,$$

colourless prisms, m. p. 110—111°, and the corresponding *acid*, $C_{12}H_4O_7(CH_3)_4$, prisms, m. p. 166—167°, were described. By the electrolytic oxidation of gallic acid in 60 per cent. sulphuric acid (compare D.R.-P. 85390), flavellagic acid, $C_{14}H_6O_9$ (*Trans.*, 1906, **89**, 251), is obtained, whereas protocatechuic acid gives catellagic acid, $C_{14}H_6O_6$ (*loc. cit.*), but the yields do not compare favourably with those previously obtained by means of persulphates. The best results with gallic acid were obtained by employing a platinum tube as anode and, passing cold water through it, using a divided cell. A current density of 0·22 ampere per square centimetre at 7—8 volts was employed, and the yield of flavellagic acid varied from 35 to 40 per cent.

For the preparation of sodium purpurogallincarboxylate, the electrolyte employed was 15 per cent. sodium acetate, and the best results were obtained without the employment of a divided cell. The solution was vigorously agitated during the electrolysis, the current density being 0·75 ampere per square dcm. and the *E.M.F.* 5—6 volts.

138. "Note on morindin." By Arthur George Perkin.

Morindin (*Morinda citrifolia*) according to Oesterle and Tisza (*Arch. Pharm.*, 1907, **245**, 534) possesses the formula $C_{27}H_{30}O_{15}$, not $C_{26}H_{28}O_{14}$ as suggested by Thorpe and Greenall (*Trans.*, 1887, **51**, 52), and gives an acetate, $C_{27}H_{21}O_{15}(C_2H_3O)_9$, m. p. 236—237°, readily soluble in alcohol. An examination of morindin (*Morinda umbellata*) by the author gave results agreeing with the older formula, $C_{26}H_{28}O_{14}$ (Found, C = 55·37; H = 5·14). The acetyl derivative, prepared by adding pyridine to the substance in acetic anhydride and boiling for three hours, forms pale yellow needles, m. p. 246—248°, very sparingly soluble in alcohol, and possessing the formula

$$C_{26}H_{20}O_{14}(C_2H_3O)_S$$

(Found, C = 56·01; H = 5·14, and, on hydrolysis, acetic acid = 53·60, morindone = 29·84, 29·99). The morindone thus produced was pure (Found, C = 66·64; H = 3·90). Morindin acetate was unaltered by long digestion with acetic anhydride, and was also formed when the method given by Oesterle and Tisza (*loc. cit.*) was employed. The sugar obtained by hydrolysis of the glucoside gave an osazone, m. p. 202—203°, sparingly soluble in alcohol, whereas that described by Oesterle and Tisza is readily soluble, and melts at 197°. Independent analyses of morindin carried out for the author at the University, Manchester, gave C = 55·10, 55·10; H = 5·00, 5·20 per cent., and it thus seems likely that the morindin present in the *Morinda citrifolia* is not identical with that contained in the *Morinda umbellata*.

139. "Some esters of arsenious acid." By William Robert Lang, John Francis Mackey, and Ross Aitken Gortner.

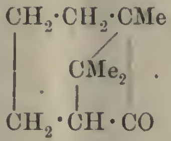
The authors have heated a number of alcohols and phenols in contact with arsenious oxide, using a reflux condenser with a Soxhlet attachment containing anhydrous copper sulphate to remove the water formed in the reaction $6ROH + As_2O_3 = 2R_3AsO_3 + 3H_2O$, otherwise a condition of equilibrium is set up at a point where only a small portion of ester has been formed. Anhydrous copper sulphate has also been employed mixed with the alcohol and arsenious oxide in the cold with good results. The following esters have been prepared in large quantities; they all decompose with water, and are capable of dissolving considerable amounts of the arsenious oxide:

	Percentage yield with anhydrous copper sulphate.	
	In Soxhlet.	Mixed together cold.
Propyl arsenite	56·75	14·8
*iso*Butyl arsenite	56·25	15·8
Trimethylcarbinol arsenite	54·27	—
Amyl arsenite	54·00	—
*iso*Amyl arsenite	58·62	17·2
Phenyl arsenite	60·00	—

Yields of 33·8 per cent. and 4·5 per cent. of methyl and ethyl arsenites respectively were obtained also, and it is found that ethyl alcohol has a much greater attraction for water than methyl or the higher alcohols, which accounts for the smallness of the yield in its case. In addition to those mentioned above, esters with the three cresols, naphthol, benzyl alcohol, the dihydric and trihydric phenols, and with methyl salicylate have all been prepared, but not quantitatively; the reaction takes place very readily. A method of analysis for the phenyl ester by titration with iodine and with dichromate was worked out and gives accurate results.

140. "α-Methylcamphor and fenchone." By Walter Hamis Glover.

The general chemical behaviour of α-methylcamphor has been contrasted with that of fenchone, and it is shown that the two substances are essentially different; thus, α-methylcamphor, unlike fenchone, is readily brominated, yielding α′-bromo-α-methylcamphor (Minguin, *Compt. rend.*, 1903, **136**, 751), and is also easily converted into a β-sulphonic acid. Fenchone, therefore, cannot possess the constitution assigned to it by Wallach (*Annalen*, 1898, **300**, 319); objections may also be raised to Semmler's formula (*Chem. Zeit.*, 1905, **29**, 1313). It is suggested that the following formula better represents the behaviour of fenchone:



$$\begin{array}{l} CH_2\cdot CH_2\cdot CMe \\ \vert \qquad\qquad / \\ \vert \qquad\quad CMe_2 \quad . \\ \vert \qquad\quad \vert \\ CH_2\cdot CH\cdot CO \end{array}$$

The following new derivatives of α-methylcamphor have been prepared; they are very similar to the corresponding derivatives of *d*-camphor.

α′-Bromomethyl-α-methylcamphor, $C_{10}H_{14}Br(CH_2Br)O$, crystallises in colourless, silky needles, m. p. 108—109°, $[\alpha]_D^{20}$ $+117·5°$ in benzene. *α-Methylcamphor-β-sulphonic acid*, $C_{10}H_{14}MeO\cdot SO_3H$, forms large, deliquescent, colourless prisms, m. p. 114—116° (decomp.), $[\alpha]_D^{20}+18·7°$ in water; the *barium* salt, $(C_{11}H_{17}O_4S)_2Ba,6H_2O$, forms large, thick, transparent, hexagonal plates, m. p. 66°; the *sulphonyl chloride*, $C_{11}H_{17}O\cdot SO_2Cl$, crystallises in transparent, prismatic needles, m. p. 33°, $[\alpha]_D^{20}$ $+29·5°$ in benzene; the *sulphonamide*, $C_{11}H_{17}O\cdot SO_2\cdot NH_2$, crystallises in long, silky needles, m. p. 150°, $[\alpha]_D^{20}$ $-6·3°$ in chloroform; the *sulphonanhydramide*, $C_{11}H_{15}ONS$, is a fine, crystalline powder, m. p. 167·5°. *β-Bromo-α-methylcamphor*, $C_{11}H_{17}OBr$, crystallises in white, silky needles, m. p. 55°, $[\alpha]_D^{25}$ $+18·8°$ in ethyl alcohol. *α-Methyl-*

camphoroxime, $C_{11}H_{18}\colon NOH$, crystallises in long, slender needles, m. p. 55°, $[\alpha]_D^{20}$ +30·3°; the *hydrochloride*, $C_{11}H_{19}ON,HCl$, forms silky needles, m. p. 138° (decomp.). *Methylcampholenonitrile* is an oil with a peppermint-like odour, b. p. 226—228°.

141. "Ester hydrolysis and theories of esterification."

By Arthur Lapworth.

The author has recently pointed out (*Proc.*, 1908, **24**, 101) that, whilst the initial velocity of hydrolysis of ethyl formate in acetone with hydrogen chloride as catalyst is roughly proportional to the respective concentrations of mineral acid and ester, it is hardly dependent on the amount of water present within a range of 4—20 per cent., and concluded that this afforded definite proof of the incorrectness of the theory advanced by Stieglitz, which demands a proportionality between the velocity and the concentration of the water. This conclusion was erroneous, because the possibility remains that the water so affects the medium (compare following note) that the effects due to its possible depressing effect on the reaction velocity, to the altered ionisation of the mineral acid, and to its own increased concentration exactly neutralise one another. It must be noted that the striking coincidence must be assumed to apply in alcoholic solution within similar limits as the results of Kistiatowski show (*Zeitsch. physikal. Chem.*, 1898, **27**, 253, *et seq.*).

Reference must here be made to the experiments of Ostwald (*J. pr. Chem.*, 1883, [ii], **28**, 463), in which the effect of replacing some of the water by acetone during ester catalysis was found to be very small.

The observed increase on the velocity of catalysed esterification with increase of alcohol concentration in acetone and water (see following note), as well as in water (van't Hoff; Kistiatowski), makes it appear very probable that the suggestion of Acree and Johnson (*Amer. Chem. J.*, 1907, **38**, 344), namely, that the alcohol and water enter into these reactions as neutral components in a complex ion formation, is correct; as an alternative it is possible (Stieglitz, *ibid.*, 1908, **39**, 60; Acree and Johnson, *loc. cit.*) that both ions of these compounds act simultaneously, but this seems less acceptable. It is not necessary, however, a priori, either for chemical or mathematical reasons, to suppose that during reactions in which carbonyl compounds take part under the influence of mineral acids it is the instantaneously formed oxonium ions which are directly concerned, and the fallacy in this assumption is obvious when it is remembered that the measured velocity of bromination of acetone (*Trans.*, 1904, **85**, 31, *et seq.*) is that of a change induced in the carbonyl compound itself by the mineral acid before the bromine enters into the reaction at all; something similar is not excluded in esterification.

142. "Experiments on the formation and hydrolysis of esters, acetals, and allied compounds." (Preliminary note.) By Edward Fitzgerald and Arthur Lapworth.

At 18·2°,. the initial velocity of hydrolysis of methyl acetate is nearly independent of the concentration of the water within the limits 4—30 per cent. in acetone.

During esterification by ethyl alcohol in acetone or ether, the velocity for a short time is roughly proportional to the concentration of the alcohol. In acetone, which appears to take no part in the reaction, alcohol depresses the initial velocity of hydrolysis of methyl acetate, but the effect of water on the reverse reaction is much greater, and the speed of esterification of acetic acid is, very roughly, inversely proportional to the concentration of water within the limits 4—20 per cent. This appears to lend considerable support to the supposition that the velocity of hydrolysis of an ester is intrinsically proportional to the concentration of the water, but is proportionately depressed by its action on the medium and the ionisation of the hydrogen chloride, but this leaves no room for the depression which water might produce on the velocity of esterification by sharing the intermediate products with the alcohol. (Depression of the velocity of esterification by water was noticed by Goldschmidt, Kistiatowski, and others.)

Methods of estimating the speed of hydrolysis of acetals and of ethyl orthoformate have been devised. The latter is hydrolysed by $N/1000$ hydrochloric acid at a speed which is too great to be followed, but in $N/5000$ hydrochloric acid (or in $N/10$ acetic acid to which an equivalent of sodium acetate has been added) the change into alcohol and ethyl formate can be traced; the velocity is more than 10,000 times as great as that of the hydrolysis of ethyl formate.

In all the above experiments, hydrogen chloride was used as catalyst, and the temperature was constant within 0·05°.

The equilibrium "constant" for esterification in acetone shows irregularities similar to those seen when acetone is absent, the proportion of ester being altered to an unexpectedly small extent by addition of excess of alcohol.

It is hoped that the ionisation factor of hydrogen chloride in the media employed having been ascertained, a further study of the reactions will throw some light on these questions.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Clausen, *Carl Conrad.* Ueber Eigenschaften des Chloral-Hydrates und -Alkoholates in Erweiterung der Mauch'schen Studie (1898), und unter Beiziehung der entsprechenden Bromverbindungen. pp. 191. Mülhausen 1907. (*Recd.* 14/5/08.) From Professor Dr. E. Schär.

Holleman, *A. F.* A text-book of organic chemistry. Translated from the third Dutch edition by *A. Jamieson* **Walker,** assisted by *Owen E.* **Mott.** Second English edition, rewritten. pp. xviii + 589. ill. New York 1907. (*Recd.* 30/5/08.).
From the Publishers: Messrs. John Wiley & Sons.

II. *By Purchase.*

Goerens, *Paul.* Introduction to metallography. Translated by *Fred* **Ibbotson.** pp. x + 214. ill. London 1908. (*Recd.* 25/5/08.)

Haber, *F.* Thermodynamics of technical gas-reactions. Seven lectures. Translated by *Arthur B.* **Lamb.** pp. xix + 356. ill. London 1908. (*Recd.* 25/5/08.)

Holley, *Clifford Dyer*, and **Ladd,** *E. F.* Analysis of mixed paints, color pigments, and varnishes. pp. xi + 235. ill. New York 1908. (*Recd.* 25/5/08.)

Schmidt, *Julius.* Synthetisch-organische Chemie der Neuzeit. pp. x + 185. Braunschweig 1908. (*Recd.* 25/5/08.)

III. *Pamphlets.*

Beveridge, *W. W. O.*, and **Fawcus,** *H. B.* Experiments with preserved meat. (From the *J. Roy. Army Medical Corps*, 1908.)

Carnegie Institution of Washington. *Geophysical Laboratory.* Annual report of the Director, 1907. (From the *Yearbook of the Carnegie Institution*, 6, 1908.)

Fairley, *Thomas.* The early history of distillation. (From the *J. Inst. Brewing*, 13, 1907.)

Hendrick, *James.* Improvement of hill pasture as determined by the effect on stock. Experiments in Scotland. Second report. (From the *Trans. Highland and Agric. Soc. of Scotland*, 1908.)

Hendriksen, *G.* Sundry geological problems. Second edition. pp. 18. Christiania 1908.

Hooper, *David.* The fats of Indian nutmegs. (From the *Agricultural Ledger*, No. 3, 1907.)

——— The seeds and oil of the Mexican poppy. (From the *Agricultural Ledger*, No. 5, 1907.)

Juritz, *Charles F.* The fertility of some colonial soils, as influenced by geological conditions. (From the *Trans. S. A. Phil. Soc.*, **18**, 1907.)

——— Analyses of grain soils. Cape division. (From the *Agric. J.*, 1908.)

——— Proportion of plant food in purple Karoo shales. (From the *Agric. J.*, 1908.)

Leather, *J. Walter.* The loss of water from soil during dry weather. (From the *Mem. Dept. Agric. India*, **1**, 1908.)

McBain, *J. W.* The experimental data of the quantitative measurements of electrolytic migration. (From the *Proc. Washington Acad. Sci.*, **9**, 1907.)

Scharff, *Ernst.* Ueber das leuchten des Phosphors und einiger seiner Verbindungen. pp. 67. Marburg 1907.

Szilard, *B.* Beiträge zur allgemeinen Kolloidchemie. pp. 42. Dresden 1908.

Wallace, *Robert.* Report on tick, redwater, or Texas fever in cattle. pp. 30. Edinburgh 1908.

LOTHAR MEYER MEMORIAL.

The Council has decided to make a donation of £10 to the Lothar Meyer Memorial Fund.

Many old pupils and admirers of the author of "Die Modernen Theorien der Chemie" may be desirous of contributing to this Memorial, and the Treasurer will be glad to receive before the end of June subscriptions from Fellows and others to the Fund.

Cheques, &c., should be made payable to Dr. Alexander Scott, crossed "Lothar Meyer Memorial Fund A/c.," and sent to the Treasurer, Chemical Society, Burlington House, W.

LIST OF FELLOWS, 1908.

The List of Fellows for 1908 is now in active preparation, and changes of address **received after 31st July cannot be included in it.**

In order that the new list may be as complete as possible, those Fellows whose degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

At the next Ordinary Meeting on **Thursday**, June **18th**, 1908, at **8.30** p.m., there will be a ballot for the election of Fellows and the following papers will be communicated :

"The thermal decomposition of hydrocarbons. Part I. (Methane, ethane, ethylene, and acetylene)." By W. A. Bone and H. F. Coward.

"The rusting of iron." By W. A. Tilden.

"Studies on elementary zirconium." By E. Wedekind and S. J. Lewis.

"The constituents of Canadian hemp. Part I. Apocynin." By H. Finnemore.

"A new synthesis of apocynin." By H. Finnemore.

"The constitution of the diazonium perbromides." By F. D. Chattaway.

"Cholestenone." By C. Dorée and J. A. Gardner.

"A new form of potash bulb." By A. E. Hill.

"Solubility of silver chloride in mercuric nitrate solutions." By B. H. Buttle and J. T. Hewitt.

"The relation between absorption spectra and chemical constitution. Part IX. The nitroso- and nitro-groups." By E. C. C. Baly and C. H. Desch.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Thursday, June 18th, 1908.

Ballantyne, William Henry,

99, Holmdene Avenue, Herne Hill, London, S.E.

Chartered Patent Agent and Consulting Chemist. B.Sc. (Glasgow). Fellow of the Chartered Inst. of Patent Agents. Studied Chemistry at Allan Glen's Technical School, Glasgow, 1894–97, and at Glasgow University, 1897–1900; "Joseph Black" medallist in Chemistry, 1897–98; Thomson Research Scholar, 1898–99; assisted Lord Kelvin, 1898–99, in researches on electrical properties of metals, alloys, &c.

J. A. Williamson.
Robert Robertson.
Horatio Ballantyne.
Frank L. Teed.
Alfred Gordon Salamon.

Bevan, Edward Morris,

10, Coronation Street, Aberkenfig.

Assistant Master responsible for the Science at the P. T. Centre, Tondû, Glam., and Lecturer in Chemistry at the Certificate Classes at Bridgend "Intermediate School." (1) Position and experience as Lecturer; (2) Inter. B.Sc., First Class, London University (Chemistry being one of the subjects of examination). Studied Practical and Theoretical Chemistry under Dr. Mills at the Northern Polytechnic, London.

W. H. Mills.
S. G. Eade.
Herbert Eccles.
E. A. Tyler.
J. M. Davey.

Blyther, Donald Francis,

77, Knights Road, Silvertown, E.

Civil Servant. Associate of the Royal College of Science, London; B.Sc. Hons., London, in Chemistry; one year in the Research Laboratory of the Royal College of Science.

William A. Tilden.
M. O. Forster.
G. T. Morgan.
James C. Philip.
J. T. Hewitt.

Brown, James,

20, Tower Road, Dartford, Kent.

Pharmaceutical Chemist. Manufacturing chemist with Messrs. Burroughs, Wellcome & Co., Dartford, Kent. I am desirous of keeping in touch with modern chemistry.

H. A. D. Jowett.
Frederic H. Lees.
F. G. P. Remfry.
M. Barrowcliff.
Francis H. Carr.
Wm. C. Reynolds.

Cooper, Charles Duncan,

The Laboratory, 776, Oxford Road, Reading.

Analyst. I wish to keep in touch with recent developments of Chemistry. I am engaged at present in investigations on a technical process.

E. A. Tyler.
Percy Edgerton.
Walter M. Gardner.
W. M. Seaber.
B. North.

Cowburn, John Robert,

Belmont Villa, Birkbeck Grove, Acton, London, W.

Technical Chemist. Advanced Student in Analytical Chemistry. Certificated "Soap Making," City and London Guilds. Fourteen years' experience as Chemist and Manager in Sulphuric Acid, Alkali, and Soap Industries.

J. E. Green.
A. W. Cowburn.
T. George Shacklady.
John E. Farmer.
William Thomson.
J. Carter Bell.

Fairweather, James Hill,

62, Wythes Road, Silvertown, E.

Analytical Chemist. I have had $5\frac{1}{2}$ years' Technical training, mainly at the West Ham Municipal Technical Institute; served as Pupil Assistant to W. C. Young, F.I.C., F.C.S., Public Analyst for West Ham, Poplar, &c., and for 5 years have been his Chief Assistant.

W. C. Young.
Harold A. Auden.
F. Henry Streatfeild.
William Ping.
W. A. Rugginz.
George Dean.

Falk, Kaufman George (B.Sc., Columbia; Ph.D., Strassburg),
1070, Madison Avenue, New York City.

Chemist, Columbia University. "Condensations of *o*-Phthalaldehyde" (with J. Thiele). "Ignition Temperatures of Gaseous Mixtures." "Stereochemistry of Indigo" (with J. M. Nelson). "Calculation of some Chemical Equilibria."

Frederick H. Getman.	Marston Taylor Bogert.
J. Livingston R. Morgan.	C. F. Chandler.

Samuel A. Tucker.

Crossley-Holland, Frank William,
Connaught Club, Marble Arch, W.

Chemist. Desires to attend the meetings of the Society; to use the Library; to keep in touch with Chemical Science.

H. A. D. Jowett.	Harold C. Sayer.
F. G. P. Remfry.	Francis H. Carr.
Harold Rogerson.	Frederic H. Lees.

Holland, Norman,
Montreal; 4907, Sherbrooke St., W.

Superintendent, McCaskill, Dougall & Co., Varnish Manufacturers (Railway and Carriage Varnishes). Two years with Dr. J. T. Donald, Dominion Government Analyst; three years Chief Chemist, Canada Iron Furnace Co. (Blast Furnaces), Radnor Forges, Que.; one year Chemist to Riordan Pulp and Paper Co., Hawkesbury, Ont.; one and a-half years Superintendent, Vermilion Chemical Co. (Electrolytic Processes), Niagara Falls, N.Y.; three years Supt., McCaskill, Dougall & Co.

G. P. Girdwood.	R. H. D. Benn.
Nevil Norton Evans.	Fred. J. Hambly.

Fred. C. Dunscombe.

Hutchinson, Henry Brougham,
Ashby Villa, Devonshire Road, Harpenden.

Agricultural Bacteriologist, Rothamsted Experimental Station. Ph.D. (Göttingen). Author of "Uber Kristallbildung in Kulturen denitn. Bakterien," *Cent. Bakt. Par.*, II., B. 16, 1906; joint author of "The Cultivation of Sugar Beet in the Midlands," *Jour. Soc. Chem. Indus.*, **26**, 1907.

A. D. Hall	E. J. Russell.
N. H. J. Miller.	J. Golding.

Horace T. Brown.

King, James Kirkman,

55, Brewery Road, Plumstead, Kent.

Schoolmaster. B.A. (Cambridge). Natural Sci. Tripos, Part I, 1st Class; Natural Sci. Tripos, Part II (Chemistry), 2nd Class. Science Master at Dean Close School, Cheltenham, since Sept., 1905.

Arthur Hutchinson.
S. Ruhemann.
H. J. H. Fenton.
Isaac S. Scarf.
R. Harold C. Birt.

Lyell, Henry Robert,

"Redcott," Dacres Road, Sydenham, S.E.

Student of Chemistry. Studied at Goldsmiths' College, 1900–1906, and at King's College from 1906 to present date.

John M. Thomson.
Herbert Jackson.
Patrick H. Kirkaldy.
Arthur Lapworth.
Reginald W. L. Clarke.
A. C. Osborn Hann.

Larmuth, Lionel Gordon,

Grove House, Cheadle Hulme, Manchester.

Manufacturing Drysalter. Attended the School of Technology, Manchester, for three years; Honours Certificate, City and Guilds; I am engaged in a Manufacturing Chemical Industry, and am desirous of keeping in touch with modern research.

W. J. Pope.
Jul. Hübner.
L. G. Radcliffe.
J. Grant.
F. S. Sinnatt.
S. J. Peachey.

Meggitt, Alfred Ash, B.Sc. (London),

Dacca, Eastern Bengal, India.

Agricultural Chemist to the Government of Eastern Bengal and Assam, India. Studied for 4 years at the University College, Nottingham, under Profs. Clowes and Kipping. Assistant Chemist and Lecturer in Dairying, Midland College of Agric., nearly 3 years. Agric. Chemist to Govt. of Bombay, and Prof. of Agric. Chemistry, Poona, from August, 1905, to November, 1907.

John Golding.
J. F. Blackshaw.
Arthur Slator.
H. Sand.
R. M. Caven.
F. Stanley Kipping.

Okell, Stanley Allen Warrington,

27, King's Road, Ealing, W.

Advanced Student of Chemistry at the Central Technical College (3rd year).

Henry E. Armstrong.
Edward Horton.
William A. Davis.
E. Wheeler.
Walter H. Glover.
William Robertson.
J. Vargas Eyre.

Ray, Haradhan, M.A.,

4, Jhamapooker Lane, Calcutta.

Senior Demonstrator of Chemistry, and Analytical Chemist, Indian Association for the Cultivation of Science. M.A., 1900 (Calcutta). Sometime Professor of Physics and Chemistry, Albert College, Calcutta. At present employed as Senior Demonstrator of Chemistry, and Analytical Chemist at the above Association for the last three years.

Chuni Lal Bose. J. Sen.
T. N. Majumdar. A. L. Sircar.
P. C. Rây.

Readwin, William,

6, Kirkfield Terrace, Morley, Nr. Leeds.

Schoolmaster and Teacher of Chemistry. Teacher of the subject for upwards of twenty years; Registered Teacher of Chemistry and Physics under the West Riding County Council; Teacher of Chemistry, Cleckheaton Technical Institute.

R. H. Adie. B. North.
W. W. Tunnicliffe. Arthur Smithells.
Geo. E. Welch.

Rutter, Clement Thomas,

4, Bath Terrace, Hanwell, W.

Chemist to the Royal General Dispensary, and to the City of London Union, St. Bartholomew Close. Studied under Dr. Muter, Past President of the Society of Public Analysts. I perform all the analytical work of the Royal General Dispensary; am a Member of the Pharmaceutical Society, and desirous of keeping in touch with the latest chemical investigations.

Hermann C. T. Gardner. Robert W. Lindsey.
O. A. Elias. Sydney Dunstan.
A. H. M. Muter.

Southcombe, James Edward,

138, Chester Street, Birkenhead, Cheshire.

Chemical Research. Asst. Chemist to the Institute of Commercial Research in the Tropics; B.Sc. (1905), Liverpool; M.Sc. (1907) in Chemistry; author of "Effect of Superheated Steam on Hydrocarbon Oils," in collaboration with T. W. Worrall (*J. Soc. Chem. Ind.*, vol. xxvii, No. 7).

J. Campbell Brown. A. W. Titherley.
F. G. Donnan. Henry Bassett, jun.
Thomas Callan.

Speed, John Day,

Mill House, Enfield Lock, Middlesex.

Metallurgical Chemist. Have been employed for the past 6 years in the laboratory of the Royal Factory, Enfield Lock, as Assistant Metallurgist, the work consisting of the usual routine of analysis of steel, alloys, and general factory supplies, also the mechanical testing of same. At present time attending special course at Finsbury College under the direction of Mr. Castell-Evans, F.I.C., F.C.S.

John Castell-Evans. *L. Dufty.*
L. H. Berry. *E. Wheeler.*
W. R. Simpson Ladell. *E. W. Bealey.*

Stewart, Alexander Mackintosh,

Penang, Straits Settlements.

Chemist. Did the analysis for some time in connection with the South British Marine Insurance Claims, Singapore, &c.; interested in chemical studies; partner in wholesale and retail chemists' business, Penang; Member of the Pharmaceutical Society of Great Britain.

John C. Hewlett. *Peter MacEwan.*
Wm. Beaverly Cowie. *William Duncan.*
E. J. Millard. *H. H. Robins.*

Stokes, Edward,

King William's College, Isle of Man.

Schoolmaster. B.A., Adelaide, 1903; Magdalen College, Oxford, B.A., 1906; Exhibitioner, Magdalen College, 1906.

N. V. Sidgwick. Harold Hartley.
T. S. Moore. D. H. Nagel.
A. F. Walden.

Ward, Herbert Horace,

University College of Wales, Aberystwyth.

Analytical Chemist. For two years as Assistant to the Public Analyst for Stepney, London; twelve months Chemist in an Electrochemical Works; three years Assistant to the Lecturer on Agricultural Chemistry in the University College of Wales, Aberystwyth, and Deputy Analyst for seven counties (under the Fertilisers and Feeding Stuffs Acts) affiliated to the College.

J. J. Sudborough. Charles A. Keane.
T. Campbell James. H. Burrows.
Albert E. Parkes.

Wright, Charles Harold,

Government Laboratory, Port of Spain, Trinidad.

Assistant Analyst and Science Master in Trinidad (appointed March, 1908). B.A. (Cantab). Formerly Scholar of Sidney Sussex College, Cambridge; A.I.C. Assistant Master at Rivington G. S. (1902–04), at Sutton Valence School (1904–05). From Sept., 1905, to March, 1908, with Thomas Fairley, F.I.C. Author of "A Temperature Correction, &c.," *J.S.C.I.*, vol. 26, 1907 (pp. 513–5).

F. H. Neville.
Arthur Smithells.
W. Lowson.
Thomas Fairley.
B. A. Burrell.
H. L. Lee.

Yates, Harry James,

Redcroft, Four Oaks, Warwickshire.

Gas Apparatus Manufacturer (Managing Director, John Wright & Eagle Range, Ltd., Gas Stove, &c., Makers). Has made numerous investigations (still in progress) into the combustion of gas in conjunction with refractory media, and has for many years carried on chemical and other work in his own physico-chemical laboratory. Has specialised in the chemistry of gases, and is the author of a number of inventions relating to the perfecting of gas combustion. Is desirous of keeping in touch with general chemical progress.

A. T. Cocking.
Horatio Ballantyne.
J. W. Helps.
Dugald Clerk.
Harry Silvester.
W. Mackean.

Young, Charles Robert,

11, Low Pavement, Nottingham.

Demonstrator in Chemistry, University of Sheffield. B.Sc. (Lond.). Joint author with Professor Purdie, F.R.S., of "The Alkylation of Rhamnose."

William A. Tilden.
M. O. Forster.
James C. Philip.
G. T. Morgan.
Chapman Jones.
W. Palmer Wynne.

The following Certificate has been authorised by the Council under Bye-Law I (3):

Vidyant, Hari Prasad, M.A., C.E.,

Etawah, United Provinces, India.

Executive Engineer, Irrigation Branch P.W. Department. M.A., First Class, first on list 1894, Allahabad University; Passed as Civil Engineer, higher certificate, first on list 1897, Roorkee Thomason Civil Engineering College, India. Prizes and Medals: Gold medal, B.A., 1892, Canning College, Lucknow; Empress Victoria Jubilee medal, M.A., 1894, Allahabad University; Council of India prize of Rs. 1000 and Thomason prize of Rs. 250 (for best student); Cantley Gold medal, Mathematics; Maclaghan prize for Experimental Science (chemistry and physics). Surveying medal, Civil Engineering medal, Drawing medal, Photography medal, Roorkee. Worked at Practical Chemistry in Canning College, and also at Roorkee Engineering College. Greatly interested in Chemistry in its applications to Engineering, Agriculture, and Photography, and so desirous of keeping in touch with modern developments.

Hem Chandra Chatterji. Gopal Ch. Banerjee.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/6/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24. No. 344

Thursday, June 18th, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

Messrs. F. W. Caton, H. F. Coward, and E. J. Watkins were formally admitted Fellows of the Society.

The President made a short communication with reference to the Seventh International Congress of Applied Chemistry, to be held in London at Whitsuntide, 1909 (May 27th to June 2nd), under the Hon. Presidency of Sir Henry Roscoe, he himself being the acting President. The King has consented to be Patron, and the Prince of Wales Vice-Patron; it is hoped that His Royal Highness will be able to open the Congress. The meetings will be held in the University Buildings, in the Imperial College of Science, and in the Central Technical College. There are special sections for (1) Analytical Chemistry; (2) Inorganic Chemistry and Allied Industries; (3) Metallurgy and Mining—Explosives; (4) Organic Chemistry and Allied Industries; (5) Industry and Chemistry of Sugar; (6) Starch Industry; (7) Agricultural Chemistry; (8) Hygiene, Medical and Pharmaceutical Chemistry—Bromatology; (9) Photographic Chemistry; (10) Electrical and Physical Chemistry, and (11) Law, Political Economics, and Legislation with reference to Chemical Industries, of which Presidents, Vice-Presidents, and Secretaries have already been appointed.

A considerable sum has already been collected privately to meet the expense of the Congress, and a general appeal will be issued shortly. The provisional Programme of the week has been drawn up; it comprises the opening meeting in the Albert Hall, a conversazione at the Natural History Museum, a banquet at the Crystal Palace, and lectures by Professor Haller, Professor Otto Witt, Professor Nasini, and Sir Boverton Redwood. Sectional meetings, at which papers will be read, will be held daily during the meeting. Committees have been formed in foreign countries to organise the work of the sections, and an Executive Committee has charge of the arrangements at home. It is anticipated that the Congress will be largely attended; meetings in Paris, Berlin, and Rome were attended by about 3000 chemists. The Hon. Sec. is Mr. William Macnab, of 10, Cromwell Crescent, S.W.

Certificates were read for the first time in favour of Messrs.:

William Colet Birch, B.A., 22, Glazbury Road, W. Kensington, W.
John Griffin, B.A., 7, Carlton Terrace, Batley.
Joseph Albert Hughes, School of Mines, Charters Towers, Queensland.
Thomas Ernest Hull, 6, Selborne Terrace, Greenbank, Darlington.
James Colquhoun Irvine, Ph.D., D.Sc., Dunmurry, Rathelpie, St. Andrews.
Frederick Martin Kay Menzies, M.D., F.R.C.P., 79, Davies Street, Berkeley Square, W.
Howard Houlston Morgan, B.Sc., Technical College, Auckland, New Zealand.

A Certificate has been authorised by the Council under Bye-law I (par. 3) in favour of:

H. V. Krishnayya, B.A., Mallesvaram, Bangalore, Mysore, India.

A Ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

William Henry Ballantyne, B.Sc.
Edward Morris Bevan.
Donald Francis Blyther, B.Sc.
James Brown.
Charles Duncan Cooper.
John Robert Cowburn.
James Hill Fairweather.
Kaufman George Falk, B.Sc., Ph.D.
Frank William Crossley-Holland.
Norman Holland.
Henry Brougham Hutchinson, Ph.D.
James Kirkman King, B.A.
Lionel Gordon Larmuth.
Henry Robert Lyell.
Alfred Ash Meggitt, B.Sc.
Stanley Allen Warrington Okell.
Haradhan Ray, M.A.
William Readwin.
Clement Thomas Rutter.
James Edward Southcombe, M.Sc.
John Day Speed.
Alexander Mackintosh Stewart.
Edward Stokes, B.A.
Hari Prasad Vidyant, M.A.
Herbert Horace Ward.
Charles Harold Wright, B.A.
Harry James Yates.
Charles Robert Young, B.Sc.

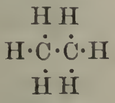
Of the following papers, those marked * were read :—

*143. "The thermal decomposition of hydrocarbons. Part I. [Methane, ethane, ethylene, and acetylene.]" By William Arthur Bone and Hubert Frank Coward.

The results of a systematic investigation of the modes of decomposition of the four hydrocarbons at temperatures between 500° and 1200° were described. The theories advanced by Berthelot, V. B. Lewes, and others were critically examined, and doubts raised as to the importance of acetylene as a factor in such processes.

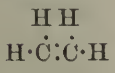
Methane, which is by far the most stable of the four hydrocarbons, and a principal product of the decomposition of the other three, decomposes for the main part *directly* into carbon and hydrogen. The decomposition is, within the range of temperature investigated, a surface effect, and the carbon deposited is of a peculiarly hard and lustrous type. The large quantities of methane formed during the decomposition of the other three hydrocarbons can only be explained on the supposition that "residues," such as $\vdots CH$ and $:CH_2$ (which may be considered to have a momentary separate existence during the dissolution process), are directly "hydrogenised" in an atmosphere rich in hydrogen. The assumption of the momentary formation of such "residues" (or the tendency to give rise to them, which actually becomes operative at moderately high temperatures) as the result of the initial dissolution of the hydrocarbon molecule, renders it possible to formulate a rational scheme of the chief causes at work, and their modes of operation in each particular case.

It may be supposed that these "residues" are capable of (*a*) forming $H_2C:CH_2$ or $HC\vdots CH$ as the result of encounters with other like residues, or (*b*) breaking down directly into carbon and hydrogen, or (*c*) combining with hydrogen to form methane, and that all three possibilities may be realised simultaneously in proportions dependent on the temperature and the amount of hydrogen present. The scheme of decomposition of the three hydrocarbons (omitting secondary "polymeric" changes, which are essentially low temperature effects) is as follows :



$$\begin{matrix}H\ H\\ H\cdot\dot{C}\cdot\dot{C}\cdot H\\ \dot{H}\ \dot{H}\end{matrix} = [2(:CH_2)+H_2] = \begin{cases}(a)\ C_2H_4+H_2.\\ (b)\ 2C+2H_2+H_2.\\ (c)\ \textit{plus}\ H_2=2CH_4\end{cases}$$

Ethane.



$$\begin{matrix}H\ H\\ H\cdot\dot{C}:\dot{C}\cdot H\end{matrix} = [2(\vdots CH)+H_2] = \begin{cases}(a)\ C_2H_2+H_2.\\ (b)\ 2C+H_2+H_2.\\ (c)\ \textit{plus}\ 2H_2=2CH_4.\end{cases}$$

Ethylene.

$$\underbrace{\underset{\text{Acetylene}}{H\cdot C\vdots CH}}_{\text{Polymerisation to } C_6H_6\text{, \&c.}} = [2(\vdots CH)] = \begin{cases}(b)\ 2C+H_2.\\(c)\ \textit{plus}\ 3H_2=2CH_4.\end{cases}$$

Discussion.

Prof. Armstrong said that the conditions under which acetylene was produced were undoubtedly peculiar; he had sought for it in vain in the oil gas produced by cracking petroleum. If formed in the process, it underwent change very readily. It was by no means necessary to assume that the benzene which was produced was formed from acetylene. He could not agree with Dr. Bone as to the influence of surfaces in the changes studied; he thought they must play a predominant part. He was in agreement with him, however, as to the manner in which methane was formed, that is to say, that it was formed by the hydrogenation of fragments.

Dr. Divers asked whether the production of methane from acetylene at 800°, in presence of large excess of hydrogen, was not sufficiently accounted for as being the result of the union of the acetylene and hydrogen with decomposition of the product into methane, without making the assumption of the temporary existence of the substance CH?

Prof. Mills referred to the great importance of the authors' investigation, especially in connexion with the manufacture of coal gas. He thought the experiments showed that hydrogen (probably on account of its less density) protected ready-made methane better than nitrogen did. Hydrocarbons, such as CH and CH_2, if they could possibly be formed, would, in his opinion, be certain to polymerise (like acetylene, for instance), and, in their polymerised state, it would be extremely unlikely that hydrogen would combine with them.

Prof. Bone, in reply, said that he was clearly of the opinion that, whilst the decomposition of methane was, within the range of temperature investigated, entirely a surface effect, in the other three cases surface played a much less prominent part. No one, he thought, could witness the sudden decomposition of acetylene at high temperature with its accompaniment of incandescence without admitting that the chemical change took place throughout the whole mass of the gas and was not confined to the layer in contact with the hot walls of the containing vessel. Time did not permit him to cite all the evidence in favour of the hypothesis that such residues as $:CH_2$ and $\vdots CH$ are actually formed during these decompositions; but he thought that when Dr. Divers and Prof. Mills had had the opportunity of studying the whole of the facts brought to light during the investigation, their doubts on that point would largely disappear. He himself felt convinced that, in the cases of ethane and ethylene, the collapse of the molecule was preceded by the elimination of hydrogen in the manner stated in the paper.

*144. “The rusting of iron.” By William Augustus Tilden.

An account was given of a series of experiments from which the following conclusions are drawn:

1. Oxygen or air together with liquid water are alone necessary to produce rusting without the assistance of carbonic acid, failure on the part of other experimenters to produce rusting in iron prepared by treatment with chromic acid being probably due to “passivity.”

2. Water alone in the absence of oxygen attacks iron slowly, producing a film of what is probably ferrous hydroxide, as it is wholly converted into brown rust on admission of pure oxygen. In this connexion, the experiments of Whitney (*J. Amer. Chem. Soc.*, 1903, **25**, 298), repeated and approved by Walker, Cederholm, and Bent (*J. Amer. Chem. Soc.*, 1907, **29**, 1255), were confirmed.

3. Iron rust even when very old and constantly exposed to the weather always contains ferrous oxide.

4. The process of rusting is due in the first instance to electrolytic action promoted in all ordinary cases by the existence of carbonic acid in water exposed to the air, and by the presence in iron of various compounds of carbon, silicon, phosphorus, and sulphur. That electrolytic action does occur locally in all commercial iron, whether malleable iron, grey or white cast iron, or steel immersed in water, is shown by the use of the “ferroxyl” indicator (phenolphthalein and ferricyanide) introduced by Walker and his colleagues, and in other ways. In ordinary rusting, the process is also assisted by the depolarising action of the layer of ferric oxide or hydroxide formed externally on the rust spot.

The conditions of rusting of pure iron have never yet been studied, inasmuch as a pure iron in a massive form, if indeed in any form, is unknown.

Discussion.

Dr. Jowett said that he was interested to know that Prof. Tilden's experiments confirmed those carried out by himself many years ago. Although there were difficulties in the hydrogen peroxide theory of rusting, he would like to know how the electrolytic theory would account for the inhibiting effects of salts like sodium nitrite and potassium ferrocyanide, and the absence of this inhibiting effect by potassium nitrate and potassium ferricyanide, &c.

Prof. Armstrong said that as they were carried out in his laboratory, he had enjoyed the opportunity of witnessing all Dr. Moody's experiments. One of his most striking observations was that a piece of iron, insulated from the glass by coating the ends with paraffin wax, had remained unrusted after many months' exposure partly immersed in water and partly in air, but, on turning the tube so that the metal came into contact with the glass at some point, the iron soon rusted. It therefore did not seem to be in a passive state. He (the speaker) thought the effect was perhaps due to silicic acid from the glass.

But even admitting, for the sake of argument, that treatment with chromic acid had rendered the iron passive, Prof. Tilden's results, important and valuable as they were, did not, in the speaker's opinion, in the least invalidate Dr. Moody's conclusions. The subject must be considered from the theoretical as well as from the practical side. Recalling the fact that, in 1885, in the course of the discussion on Mr. Brereton Baker's communication on "Combustion in Dried Gases," he had insisted that the conditions to be satisfied in the case of any chemical change were those involved in a galvanic cell—that the system must contain an electrolyte—Prof. Armstrong said that this contention had been entirely justified by later observations, especially by Mr. Baker's work on the interaction of hydrogen and oxygen. Not only was a dry mixture of these gases inert, but the presence even of liquid water was not sufficient to determine interaction; dirty water—water containing impurity which rendered it an electrolyte—alone conditioned the change. From this point of view, it was impossible that interaction should set in between iron, water and oxygen: some trace of acid impurity must be present to condition the change.

Prof. TILDEN, in reply, recalled the familiar fact that water in contact with glass became alkaline and not acid, and that, although he could not profess to account for the effects produced by all the salts mentioned by Dr. Jowett, it was obvious that all those which, like alkalis, produced hydroxyl ions in aqueous solutions would tend to retard the process of rusting.

*145. "Studies on zirconium."

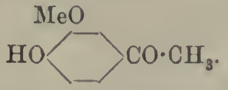
By Edgar Wedekind and Samuel Judd Lewis.

The authors have studied the chemical and physical properties of zirconium. From a specimen containing 95·55 per cent. of zirconium and 4·14 per cent. of oxygen, the value 14 was obtained for the atomic volume and the values 6·078 and 6·753 for the atomic heat.

146. "The constituents of Canadian hemp. Part I. Apocynin." By Horace Finnemore.

The principal constituent of the root of *Apocynum cannabinum* (0·2 per cent.) is identical with the crystalline apocynin of commerce, and with the product previously isolated by Wood (*J. Amer. Med. Assoc.*, 1904, **43**, 1953) for pharmacological purposes.

Apocynin, $C_9H_{10}O_3$, which has a faint odour of vanillin, forms slender, colourless prisms, m. p. 115°. It is convertible into a crystalline *potassium* derivative, and into *acetyl*, *benzoyl*, and *methyl* derivatives, m. p. 57°, 106°, and 51° respectively; it yields an *oxime* and a well-defined *hydrazone* and *semicarbazone*, m. p. 126° and 167° respectively; its molecule contains a single methoxyl group. As it has no aldehydic properties, it follows that apocynin is a hydroxymethoxyacetophenone. It is in fact identical with the acetovanillone (4-hydroxy-3-methoxyacetophenone) obtained by Tiemann (*Ber.*, 1891, **24**, 2855) from *iso*eugenol, and by Goldschmiedt and Hemmelmayr (*Monatsh.*, 1894, **35**, 338) from scoparin, and has the constitution (compare following abstract):



The pharmacological properties of apocynin are under investigation. A synthesis of acetovanillone from vanillic acid by Neitzel (*Ber.*, 1891, **24**, 2863) could not be confirmed, and another by T. Otto (*ibid.*) gave a yield too small for practical use; the product, however, was identical with apocynin.

147. "A new synthesis of apocynin." By Horace Finnemore.

The previously known syntheses of apocynin (acetovanillone) being unsatisfactory (preceding abstract), the author has synthesised this substance from vanillin by an application of the Grignard process. Benzoylvanillin, $C_6H_3(OBz)(OMe)\cdot CHO$, is converted by magnesium methiodide, with subsequent hydrolysis, into *benzoylapocynol*,

$$MeO\cdot C_6H_3(OBz)\cdot CH(OH)\cdot CH_3,$$

m. p. 128°, the phenolic benzoyl derivative of the secondary alcohol corresponding with apocynin. This benzoyl compound is oxidised by chromic acid mixture to *benzoylapocynin*, $MeO\cdot C_6H_3(OBz)\cdot CO\cdot CH_3$, m. p. 106°, which gives on hydrolysis 4-*hydroxy*-3-*methoxyacetophenone*, $MeO\cdot C_6H_3(OH)\cdot CO\cdot CH_3$, m. p. 115°; this is identical with natural apocynin, and with acetovanillone prepared from guaiacol (preceding abstract). The yields throughout are good.

Apocynol or *4-hydroxy-3-methoxyphenylmethylcarbinol*,

$$MeO\cdot C_6H_3(OH)\cdot CH(OH)\cdot CH_3,$$

m. p. 101°, obtained by hydrolysing the above synthetic benzoyl derivative, may also be formed, although with poor yield, directly from apocynin by the action of sodium amalgam. This alcohol and the corresponding *dihydroxycarbinol*, $C_6H_3(OH)_2\cdot CH(OH)\cdot CH_3$, that is formed from it by the action of suitable hydrolytic agents, promise to be of interest pharmacologically by reason of their very close relation to adrenaline.

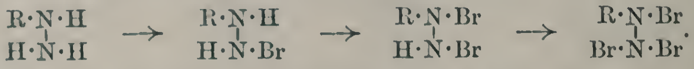
148. "The constitution of the diazonium perbromides."

By Frederick Daniel Chattaway.

The view first suggested by Kekulé as an alternative and rejected by him, that the diazonium perbromides have the constitution $R\cdot NBr\cdot NBr_2$, that is, are tri-*N*-bromo-derivatives of the hydrazines, receives strong support from the fact that they are produced quantitatively when the required amounts of bromine are added to aromatic hydrazines dissolved in acetic acid.

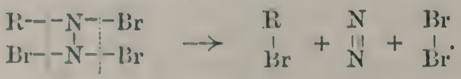
The author has recently shown (*Trans.*, 1898, **93**, 852) that diazonium bromides are produced quantitatively by the action of bromine on the hydrazines, and has expressed the view that these compounds when in acid solution are really di-*N*-bromo-substituted hydrazines, which are produced from the hydrazines by a process of substitution exactly similar to that which occurs when other compounds containing hydrogen attached to nitrogen are submitted to the action of bromine.

According to this view, the production of diazonium perbromides thus is the final and completing step in the replacement of the hydrogen of the $-NH\cdot NH_2$ group by bromine, thus:



$$\begin{array}{c}R\cdot N\cdot H\\ \vert\\ H\cdot N\cdot H\end{array} \longrightarrow \begin{array}{c}R\cdot N\cdot H\\ \vert\\ H\cdot N\cdot Br\end{array} \longrightarrow \begin{array}{c}R\cdot N\cdot Br\\ \vert\\ H\cdot N\cdot Br\end{array} \longrightarrow \begin{array}{c}R\cdot N\cdot Br\\ \vert\\ Br\cdot N\cdot Br\end{array}.$$

The entire behaviour of the diazonium perbromides is in accord with this view of their constitution, for example, they are in exactly the condition necessary for the typical diazo-decomposition to take place; this, in fact, occurs when they are heated, suspended either in chloroform or glacial acetic acid, thus:



$$\begin{array}{c}R-N-Br\\ \vert\\ Br-N-Br\end{array} \longrightarrow \begin{array}{c}R\\ \vert\\ Br\end{array} + \begin{array}{c}N\\ \vert\vert\vert\\ N\end{array} + \begin{array}{c}Br\\ \vert\\ Br\end{array}.$$

All the members of the group of diazonium trihaloids have without doubt a similar constitution.

149. "Cholestenone." By Charles Dorée and John Addyman Gardner.

Cholestenone, the ketone produced by the oxidation of cholesterol under suitable conditions, reacts with ozone in chloroform solution, giving an ozonide which most probably has the formula $C_{27}H_{44}O\cdot O_7$. This, when decomposed by water, gives carbon dioxide and a ketomonocarboxylic acid, $C_{26}H_{42}O_3$, which is identical with the one obtained by Windaus (*Ber.*, 1906, **39**, 2008) by the oxidation of cholestenone with neutral permanganate. The work, therefore, confirms the opinion of Windaus that the double bond in cholestenone is situated in a terminal vinyl group. Cholesterol, on similar treatment, gives an ozonide, $C_{27}H_{46}O\cdot O_3$, which also evolves carbon dioxide on treatment with water.

Cholesterol, therefore, must possess a similar "carbon skeleton" to cholestenone, a point which had previously been regarded as doubtful.

150. "Solubility of silver chloride in mercuric nitrate solution." By Bertram Haward Buttle and John Theodore Hewitt.

The authors have studied the solubility of silver chloride in solutions of mercuric nitrate at 25°, using variable concentrations of mercuric nitrate, nitric acid, silver nitrate, and hydrochloric acid. Alteration in the concentration of the nitric acid, the other components remaining constant, has the effect of slightly increasing the precipitation of silver chloride.

From the results obtained when only the silver nitrate or hydrochloric acid is varied, the concentration of the other three components remaining unchanged, the authors arrive at the same conclusion as Morse (*Zeitsch. physikal. Chem.*, 1902, **41**, 709), that when mercuric nitrate is present in large excess, chlorine only occurs as $HgCl^{\cdot}$ ions.

151. "The relation between absorption spectra and chemical constitution. Part IX. The nitroso- and nitro-groups." By Edward Charles Cyril Baly and Cecil Henry Desch.

The absorption spectra of compounds containing the $-NO$ and the $-NO_2$ groups have been examined. In order to guard against the disturbing influence of the benzene nucleus, the majority of compounds examined were aliphatic, several inorganic compounds being included for the sake of comparison. The results obtained show that both groups give rise to definite selective absorption, the oscillation frequency of which, in the case of the –NO group, is strikingly low. Moreover, it is found that the nature of the atom to which the above groups are directly linked exerts a very considerable influence on the position of the band.

152. "Benzeneazo-2-pyridone."

By William Hobson Mills and Sibyl T. Widdows.

An alkaline solution of 2-pyridone couples with benzenediazonium chloride to yield bright yellow 5-*benzeneazo*-2-*pyridone* (m. p. 210—212°), the constitution of which has been established by the following synthesis. 6-*Chloronicotinamide* (m. p. 210—211°) was converted by sodium hypobromite into 2-*chloro*-5-*aminopyridine* (m. p. 82—83·5°). This reacts with nitrosobenzene to form 2-*chloro*-5-*benzeneazopyridine* (m. p. 108—109°), which was converted by sodium methoxide into 5-benzeneazo-2-pyridone, identical with the above product.

3-Hydroxypyridine also couples in alkaline solution with benzenediazonium chloride, giving rise to *benzeneazo*-3-*hydroxypyridine* (m. p. 167—169°).

The preparation of 5-*amino*-2-*pyridone*, its characterisation by its *dibenzoate*, $C_6H_5{\cdot}CO{\cdot}NH{\cdot}C_5H_3N{\cdot}O{\cdot}CO{\cdot}C_6H_5$ (m. p. 211—212°), and its production together with aniline by reduction of 5-benzeneazo-2-pyridone were also described. The base was prepared in the two following ways: (1) From hydroxynicotinic acid by Curtius' method (*Ber.*, 1894, **27**, 778); ethyl hydroxynicotinate (m. p. 149—150°) is transformed through the *hydrazide* (m. p. 310°) and *azide* (m. p. 139—140°) into *bishydroxypyridylcarbamide*, $CO(NH{\cdot}C_5H_3N{\cdot}OH)_2$, which gives rise to the base on hydrolysis. (2) From the above 2-chloro-5-aminopyridine by the action of sodium methoxide.

153. "The electrolytic chlorination of the salts of some organic acids." By John Kenneth Harold Inglis and Fred Wootton.

The authors have examined the products obtained by the electrolysis of solutions containing a mixture of potassium halide with the potassium salt of an organic acid. It was found necessary to protect the liquid from the reducing action of the hydrogen by means of a porous pot. The results varied with the temperature and type of electrode employed. In the case of a solution containing potassium benzenesulphonate and potassium chloride, to which most attention has so far been paid, tri- and tetra-chloro-*p*-benzoquinone were formed if the solution was kept hot and a platinum-foil electrode used. At the same time, evidence was obtained of the production of mono-, di-, and tri-chlorobenzenesulphonates, substitution in the nucleus having taken place. These substitution products have not yet been satisfactorily separated. In a similar manner, using potassium bromide, tetrabromo-*p*-benzoquinone was produced. A platinum-gauze electrode gave different products, which have not yet been investigated. Indefinite results were obtained with sodium benzoate, phenol, and *p*-nitrophenol. When iodide was used instead of chloride, no substitution was detected.

154. "The action of nitrous gases on di*cyclo*pentadiene." By Alexander Rule.

The author has investigated the crystalline products formed by the action of nitrous gases on a well-cooled ethereal solution of di*cyclo*pentadiene.

The gaseous products from the action of nitric acid on arsenious oxide bring about the formation of a mixture which, on separation by means of alcohol, was found to consist of the ψ-nitrosite and the dinitro-derivative of the hydrocarbon.

The ψ-nitrosite is insoluble in cold alcohol, but on boiling is gradually dissolved, being at the same time decomposed into two molecules of nitro*iso*nitrosodi*cyclo*pentadiene. Sodium methoxide acts on the ψ-nitrosite with the formation of *iso*nitromethoxydi*cyclo*pentadiene and sodium hyponitrite. The methoxy-derivative, on treatment with nitric acid, forms a brilliant blue ψ-nitrol, which is very unstable.

The dinitro-derivative is soluble in alcohol, and thus may be easily separated from the ψ-nitrosite. It forms characteristic crystals, which melt at 121°.

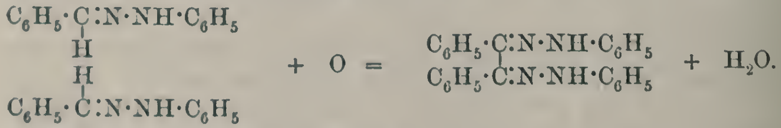
Sodium hydroxide acts on the dinitro-derivative, forming *nitrohydroxydi*cyclo*pentadiene*, which also forms a characteristic, unstable blue *ψ-nitrol* with nitrous acid. The *sodium* salt of nitrohydroxydi*cyclo*pentadiene is obtained as a crystalline mass by cooling the alkaline solution, but the free hydroxy-compound shows very little tendency to crystallise.

155. "An alternative structure for the supposed stereoisomeric α-osazones." By Frederick Daniel Chattaway.

By adding iodine to an ethereal solution of benzaldehydephenylhydrazone containing sodium ethoxide, Ingle and Mann (*Trans.*, 1895, **67**, 606) obtained two isomeric substances of the formula $C_{26}H_{22}N_4$, melting at 186° and 208° respectively. The isomeride of lower melting point was identified with diphenyldibenzylidenehydrotetrazone, first obtained by Minunni (*Gazzetta*, 1892, **22**, ii, 217) by oxidising benzaldehydephenylhydrazone with mercuric oxide, and subsequently by von Pechmann (*Ber.*, 1893, **26**, 1045), using amyl nitrite as the oxidising agent.

Ingle and Mann made the further observation that the second isomeride, melting at 208°, was transformed into ordinary benzilosazone on heating with various solvents. Entirely on the ground that stereoisomerides of benzilosazone were required by the Hantzsch-Werner hypothesis, they assumed that their newly-discovered compound was one of these much sought for isomerides, and named it benzil-α-osazone. In order to determine its configuration, they heated both it and ordinary benzilosazone with cold concentrated sulphuric acid, and found that from the former only were they able to obtain, among other products, benzaldehyde. From this circumstance, they favoured the *syn*-configuration for the supposed new modification.

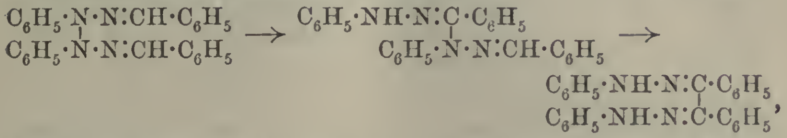
Biltz (*Annalen*, 1899, **305**, 165; **308**, 1) discovered later that Ingle and Mann's benzil-α-osazone and a whole series of similar compounds could be obtained by dissolving the corresponding hydrazones in alcohol in presence of potassium hydroxide and oxidising them by a current of air. He observed that, like the first discovered compound, all these so-called α-modifications could be transformed by heat into the corresponding β-modifications derivable directly from the diketones. Biltz offers no evidence that these new compounds are stereoisomerides of the ordinary osazones, but accepts Ingle and Mann's assumption that this is the case; indeed, he seems to regard both isomerides as formed by direct removal of hydrogen attached to carbon, and formulates the reaction thus:



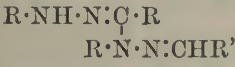
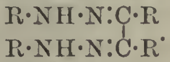
$$\begin{array}{l} C_6H_5\cdot C\colon N\cdot NH\cdot C_6H_5 \\ \qquad | \\ \qquad H \\ \qquad H \\ \qquad | \\ C_6H_5\cdot C\colon N\cdot NH\cdot C_6H_5 \end{array} + O = \begin{array}{l} C_6H_5\cdot C\colon N\cdot NH\cdot C_6H_5 \\ C_6H_5\cdot C\colon N\cdot NH\cdot C_6H_5 \end{array} + H_2O.$$

Ingle and Mann in their paper record an observation which, properly interpreted, gives a far more likely explanation of this isomerism than that afforded by the Hantzsch-Werner hypothesis, and in this connexion it should be noted that in no case has the third modification of these osazones predicted by this hypothesis been obtained. They show that the diphenyldibenzylidenehydrotetrazone obtained as one of the products of their reaction undergoes intramolecular rearrangement into ordinary benzil-β-osazone on heating with alcoholic potash.

Now this isomeric change of diphenyldibenzylidenehydrazotetrazone into benzilosazone under the influence of alcoholic potash must without doubt take place in two stages, thus:



$$\begin{array}{l}C_6H_5\cdot N\cdot N{:}CH\cdot C_6H_5\\ C_6H_5\cdot N\cdot N{:}CH\cdot C_6H_5\end{array} \longrightarrow \begin{array}{l}C_6H_5\cdot NH\cdot N{:}C\cdot C_6H_5\\ C_6H_5\cdot N\cdot N{:}CH\cdot C_6H_5\end{array} \longrightarrow \begin{array}{l}C_6H_5\cdot NH\cdot N{:}C\cdot C_6H_5\\ C_6H_5\cdot NH\cdot N{:}C\cdot C_6H_5\end{array},$$

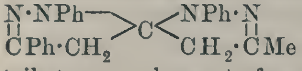
and, in the absence of all evidence to the contrary, Ingle and Mann's benzil-α-osazone (m. p. 208°) ought certainly to be regarded as the intermediate product of this transformation. The presence of benzaldehyde among the products of its decomposition by sulphuric acid is direct evidence in favour of this view. The author has recently shown that hydrogen attached to nitrogen in aromatic hydrazines is attacked with extraordinary readiness by free oxygen (Chattaway, *Trans.*, 1897, **91**, 1323), and his observations leave little doubt that the primary products when hydrazones are oxidised by air are hydrotetrazones, which thus undergo more or less complete transformation according to conditions. In Biltz's experiments, when the temperature is low, the first stage of transformation only occurs, the so-called α-osazones, which are really compounds of the general formula  $\begin{array}{l}R\cdot NH\cdot N{:}C\cdot R\\ \quad R\cdot N\cdot N{:}CHR\end{array}$, being formed; on the other hand, when the temperature is higher, the second stage of the transformation occurs and the β-compounds result, these only being true osazones of the general formula  $\begin{array}{l}R\cdot NH\cdot N{:}C\cdot R\\ R\cdot NH\cdot N{:}C\cdot R\end{array}$.

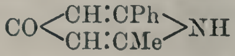
Baly, Tuck, Marsden, and Gazdar (*Trans.*, 1907, **91**, 1579) have recently examined the absorption spectra of benzilosazone and its so-called α-isomeride. Finding them identical, they regard this as very striking and clear proof that the substances have the same configuration in solution. This appears to be a wholly unwarranted conclusion. Although such band absorptions, when different, may point to a difference of constitution, it can hardly be claimed that similarity of absorptions in such complex molecules as those in question can prove identity of configuration. To do this it would first be necessary to show that in presence of four phenyl groups a shift of one linking from nitrogen to carbon would produce an appreciable effect.

156. "The formation of 4-pyrone compounds from acetylenic acids. Part II." By Siegfried Ruhemann.

2-Phenyl-6-methyl-4-pyrone, which is formed by the action of sodium ethoxide on a mixture of acetone and ethyl phenylpropiolate (*Trans.*, 1908, **93**, 431), has been examined on lines similar to those which have been followed up by Feist (*Annalen*, 1890, **257**, 253) in his work on dimethyl-4-pyrone. Under the influence of baryta, the former compound is transformed into *benzoylacetylacetone*,

$$C_6H_5{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CH_3$$

(m. p. 106—107°). This triketone does not condense with aldehydes in the presence of piperidine or alkalis as catalysts. It reacts with two molecules of phenylhydrazine to yield a colourless *substance*, $C_{24}H_{22}N_4$ (m. p. 174—175°), which only slightly reduces Fehling's solution on boiling, and which, most probably, has the constitution  $\begin{matrix}\mathrm{N{\cdot}NPh}-\\ \|\\ \mathrm{CPh{\cdot}CH_2}\end{matrix}>\mathrm{C}<\begin{matrix}\mathrm{NPh{\cdot}N}\\ \|\\ \mathrm{CH_2{\cdot}CMe}\end{matrix}$ (see Feist, *loc. cit.*). With ammonia, the triketone condenses to form 2-*phenyl*-6-*methyl*-4-*pyridone*,



$$\mathrm{CO}<\begin{matrix}\mathrm{CH{:}CPh}\\ \mathrm{CH{:}CMe}\end{matrix}>\mathrm{NH}$$

(m. p. 177—178°). This compound is characterised by the fact that its aqueous solutions readily gelatinise. Several salts of the pyridone have been prepared.

157. "The fluorescence of platinocyanides."
By Leonard Angelo Levy.

Barium platinocyanide exists in two forms, which exhibit a remarkable difference in their physical properties. One variety is golden-yellow and only very slightly fluorescent, the other variety being bright green and very fluorescent. The two forms are identical in crystalline character. The yellow salt is deposited from slightly acidified solutions, whereas the green form is best obtained by crystallisation from solutions containing a trace of barium hydroxide or barium cyanide. The experiments performed lead to the conclusion that the two forms have the same chemical composition and are isomeric modifications. Similar phenomena are exhibited by the calcium salt, and to a certain extent by the cerium salt.

Barium platinocyanide, prepared from radioactive barium chloride, exhibits a strong luminosity, which is superior to that shown by a mechanical mixture of radioactive barium chloride and barium platinocyanide.

The property of fluorescence of a platinocyanide under the stimulus of radium radiations is usually exhibited in a marked degree by one hydrate form in particular. The others usually exhibit a feeble fluorescence or else show none whatever.

Certain regularities may be observed in the spectra of the fluorescence exhibited by platinocyanides of metals of the same group.

158. "The preparation of disulphides. Part II. The action of alkalis on sodium alkyl thiosulphates." By Thomas Slater Price and Douglas Frank Twiss.

The interaction between alkalis and sodium ethyl and benzyl thiosulphates in aqueous solution has been studied. The chief organic product of the action in each case is the corresponding disulphide, the main step of the reaction being probably represented by the equation :

$$R{\cdot}S_2O_3Na + NaOH = RS^- + Na_2SO_3 + {}^-OH.$$

The RS⁻ residues couple, in part, to give disulphide, whilst, at all events in the case of the benzyl compound, part of the RS⁻ residues are oxidised, sodium benzyl thiosulphate giving appreciable quantities of benzoic and thiobenzoic acids.

The results were discussed in comparison with those of Gutmann (*Ber.*, 1908, **41**, 1650), who, using alcoholic solutions, has arrived at a different view of the action.

159. "Note on the formation of lead ethoxide." By Frederick Mollwo Perkin.

When thin sheets of lead are boiled in alcohol or suspended in the vapour of boiling alcohol, no action takes place, but if they are suspended over absolute alcohol and ozone is bubbled through it, in a short time the surface of the lead becomes tarnished and then assumes a brownish-yellow colour. At the end of some days, the whole of the lead is converted into a light yellow powder. On carefully washing this powder with alcohol and placing in an evacuated desiccator over sulphuric acid for some hours, a light yellow, friable powder is obtained. This, on analysis, proves to be *lead ethoxide*, $Pb(OEt)_2$. It appears to be soluble in water, although a clear solution is never obtained, probably owing to hydrolysis. It has not been found possible to obtain the ethoxide by passing oxygen alone through the alcohol, but, after the ozone has been passed for some time, the reaction can be completed by the continued passage of dry oxygen. When mercury is placed in alcohol and ozone bubbled through it, a white powder is formed which has not yet been analysed. The method is being tried with other metals.

160. "Some reactions of phenylhydrazine with metallic cyanides and other salts." By Robert de Jersey Fleming Struthers.

Phenylhydrazine in alcoholic solution combines with cuprous cyanide in ammoniacal solution to form an insoluble compound,

$2CuCN,3C_6H_5\cdot NH\cdot NH_2$. This, superficially, closely resembles the compound obtained (*Proc.*, 1905, **21**, 95) by heating cuprous cyanide in an excess of phenylhydrazine, being similarly composed of shining scales, which gradually oxidise in air and acquire a brilliant coppery sheen. These scales consist of microscopic crystals, the angles of which have now been successfully measured.

The substance readily decomposes on heating, nearly according to the equation :

$$2(2CuCN,3C_6H_5\cdot NH\cdot NH_2) = 4CuCN + 3N_2 + 3C_6H_6 + 3C_6H_5\cdot NH_2 + 3NH_3.$$

This, together with the previously described compound,

$$CuCN,C_6H_5\cdot NH\cdot NH_2,$$

co-ordinates with Moitessier's series of three compounds of phenylhydrazine with cuprous chloride, bromide, and iodide respectively (*Bull. Soc. chim.*, 1899, [iii], **21**, 666), and fills up the gaps, as below :

$$2Cu_2(CN)_2,4C_6H_5\cdot N_2H_3 ;\ 2Cu_2Cl_2,5C_6H_5\cdot N_2H_3,$$
$$2Cu_2(CN)_2,6C_6H_5\cdot N_2H_3 ;\ 2Cu_2Br_2,7C_6H_5\cdot N_2H_3,$$
$$2Cu_2I_2,8C_6H_5\cdot N_2H_3.$$

Cobalt cyanide is found to exert a powerful catalytic action on phenylhydrazine, 0·03—0·04 gram sufficing to determine the decomposition of 5 or 6 c.c. of phenylhydrazine with almost explosive violence. The mixture is heated near its boiling point for a short time until action is thoroughly established. The flame is then removed, but the action progresses with increasing intensity, and much evolution of heat, until the phenylhydrazine is completely decomposed. This catalysis by cobalt may be kept under control if only a few milligrams of the cyanide are added to 4 or 5 grams of phenylhydrazine, and the mixture distilled over paraffin, keeping the temperature carefully as low as 200°. In this way the evolved nitrogen may be easily collected and measured. The products appear to be principally aniline, benzene, ammonia, and nitrogen.

Nickel cyanide has a similar, but less, powerful action. Other salts of cobalt and nickel appear also to act more or less as catalysts. It seems possible that reduction may first occur, and the reduced metal be the true catalyst, although metallic nickel, not very finely divided, had only a slight effect. This action of cobalt is much more powerful than that of cuprous cyanide as described in the previous paper.

Other salts of copper have a strong catalytic action ; cupric chloride is nearly comparable with cobalt cyanide, and finely-divided metallic copper (precipitated by iron) is fairly powerful as a catalyst. The acetate and sulphate, which deposit the metal as a mirror, are less powerful. Other metallic salts, such as lead and bismuth, seem to exert less action. In the case of lead acetate, a mirror of lustrous and coherent lead was deposited on the glass, resembling the copper mirror obtained by Chattaway, as described by him recently.

161. "The formation of polyiodides in nitrobenzene solution. Part III. The chemical dissociation of the polyiodides of the alkali metals and ammonium radicles." By Harry Medforth Dawson.

A method has been devised by means of which the chemical dissociation in nitrobenzene solutions containing iodine and iodides of the alkali metals and substituted ammonium bases can be measured. This consists in the determination of the composition of the aqueous solutions which are in equilibrium with nitrobenzene solutions containing known quantities of iodide and iodine; from relationships which have been previously established for aqueous iodide-iodine solutions, the concentration of the free iodine in the aqueous solutions can be calculated, and from this the concentration of the free iodine in the nitrobenzene solutions is obtained.

It was shown that polyiodides of the types MI_9, MI_7, MI_5, and MI_3 exist in nitrobenzene solutions, and that these represent the successive steps in a dissociation phenomenon in which iodine is the other product of dissociation. In solutions of the same molar concentration, the polyiodides of the different alkali metals and ammonium bases are chemically dissociated to the same extent; this is probably due to the fact that the polyiodides are largely ionised, and the iodine resulting from the dissociation of a complex iodine ion which is common to the various polyiodides. Whereas the higher polyiodides are chemically dissociated to a considerable degree, the tri-iodides are very stable, and are but very slightly dissociated.

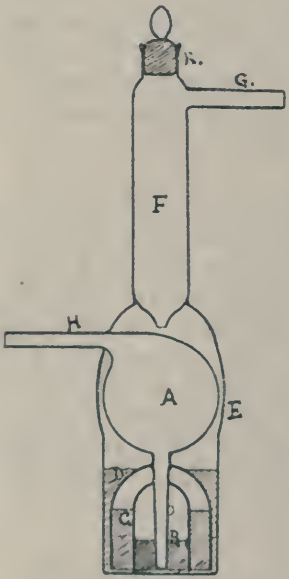
162. "The hydrolysis of amygdalin by emulsin. Part II." By Samuel James Manson Auld.

By observation of the change of rotation of the dextrose produced during the hydrolysis of mandelonitrile glucoside by emulsin and the approximate constancy of the rotation after hydrolysing amygdalin by emulsin, it is possible to show that amygdalin is derived from an $\alpha\beta$-disaccharide, the β-dextrose residue being attached to the benzaldehydecyanohydrin nucleus.

Exact measurement of the quantities of hydrocyanic acid, benzaldehyde, and dextrose formed from amygdalin shows that mandelonitrile glucoside is formed as an intermediate product during the hydrolysis by emulsin, the biose ether-linking breaking preferentially. By stopping the hydrolysis at a suitable point, it is possible actually to isolate Fischer's glucoside.

163. "A new form of potash bulb." By Arthur Edwin Hill.

The potash bulb indicated in section in the figure consists essentially of the inlet tube *AB*, made up of the bulb *A* and its lower extension the narrow tube *B*, which extension is surrounded by, and fused to, the glass domes *C* and *D*. Enclosing these is the outer vessel *E*, to which *H*, the upper part of the inlet tube, is fused. The exit tube *F*, which is drawn off at its lower end to serve as a receptacle for holding soda-lime, is fused to the top of the vessel *E*, and provided with a ground stopper *K* and side outlet tube *G*.



To prepare the potash bulb for use, the ground stopper *K* is withdrawn, and a small plug of glass wool is inserted and pushed to the bottom of the tube *F*. Recently-ignited soda-lime, free from fine particles, is then poured into the tube until it is three parts full, and the remaining space is filled with small granules of calcium chloride; a small plug of glass wool is inserted at the top, and the ground stopper is replaced. One such filling will last for at least twenty experiments.

The bulk of the carbon dioxide is absorbed with a concentrated solution of potassium hydroxide, which is contained in the vessel *E*, and renewed after every experiment. Any residual traces of carbon dioxide are removed by the soda lime in the tube *F*, which also assists the calcium chloride to desiccate the gases before they leave the potash bulb.

A special feature of the potash bulb, which makes it very efficient, is the introduction of the domes *C* and *D*, which cause the gases to bubble through the potash solution three times in succession before they can come into contact with the soda lime in the tube *F*.

After the gases have entered the bulb *A*, they pass down the narrow tube *B*, and bubble up through the solution into the dome *C*;

they leave this through two holes in its wall, and bubble up through more solution into the outer dome *D*, which they then leave through two holes in its wall to enter the outer vessel *E*, after bubbling through the solution surrounding the dome *D*.

The position of these holes is so arranged that the gases must bubble through at least a quarter of an inch of potash solution each time; sufficient solution must be introduced into the potash bulb to cover the top of the dome *D* when the gases are bubbling through the solution. The section of the dome *D* is made elliptical in order to increase the quantity of solution adjoining the holes through which the gases bubble.

Although this bulb was designed for absorbing carbon dioxide, it can also be used for absorbing water vapour. For this purpose, the tube *F* is filled with granulated calcium chloride, and concentrated sulphuric acid is substituted for potassium hydroxide solution in the vessel *E*.

This new form of potash bulb presents a number of advantages.

(1) A treble scrubbing action, which ensures a very complete absorption by means of a comparatively small quantity of liquid absorbent, supplemented by a final scrubbing with soda-lime and calcium chloride, which also ensures complete desiccation.

(2) It is very compact and strong, being free from most of the weaknesses which characterise many of the potash bulbs now in use. It is easily manipulated, and will stand on its own base.

(3) It can be easily and rapidly wiped dry before it is weighed, and will therefore give thoroughly concordant results, which are not affected by the amount of moisture in the surrounding air.

THE LIBRARY.

The Library will be closed for Stocktaking from **Monday, August 10th**, until **Saturday, August 22nd**, 1908, inclusive.

Fellows are particularly requested to return all Library Books in their possession **not later than Wednesday, August 5th.**

LOTHAR MEYER MEMORIAL.

The Council has decided to make a donation of £10 to the Lothar Meyer Memorial Fund.

Many old pupils and admirers of the author of "Die Modernen Theorien der Chemie" may be desirous of contributing to this Memorial, and the Treasurer will be glad to receive before the end of June subscriptions from Fellows and others to the Fund.

Cheques, &c., should be made payable to Dr. Alexander Scott, crossed "Lothar Meyer Memorial Fund A/c.," and sent to the Treasurer, Chemical Society, Burlington House, W.

LIST OF FELLOWS, 1908.

The List of Fellows for 1908 is now in active preparation, and changes of address **received after 31st July cannot be included in it.**

In order that the new list may be as complete as possible, those Fellows whose degrees and Christian names do not appear in full are requested to communicate them to the Assistant Secretary.

The next Ordinary Meeting will be held on **Thursday**, October **22nd**, 1908, at **8.30** p.m.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/10/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24 No. 345

The following are abstracts of papers received during the vacation and published or passed for publication in the *Transactions*:

164. "The use of the micro-balance for the determination of electrochemical equivalents and for the measurement of densities of solids."* By Otto Brill and Clare de Brereton Evans (Trans., 1908, 1442.)

By the use of the micro-balance the electrochemical equivalent of copper is found to be 31·95, and that of antimony, 40·9, the amount of metal used being from one-third to one-half of a milligram. The instrument may also be employed for determining the densities of solids which can be obtained in regular form, and thus measurable with a microscope. Results agreeing with those recorded by previous investigators were obtained by using about half a milligram of the substances selected.

165. "The preparation of disulphides. Part III. The nitrobenzyl disulphides." By Thomas Slater Price and Douglas Frank Twiss. (Trans., 1908, 1401.)

The authors have prepared o-, m-, and p-*nitrobenzyl disulphides* by the action of alkali on solutions of the corresponding nitrobenzyl thiosulphates (compare Price and Twiss, *Trans.*, 1908, **93**, 1395).

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* This paper was taken as read at the meeting of May 21st, 1908.

The solution of the complex thiosulphate is obtained in each case by boiling together an aqueous solution of sodium thiosulphate and an alcoholic solution of the nitrobenzyl chloride. The most satisfactory alkali for the subsequent action is sodium carbonate. The *o*-, *m*-, and *p*-disulphides obtained melt at 109·5°, 103°, and 126·5° respectively.

166. "The relation between unsaturation and optical activity. Part III. Optically active salts of acids containing adjacent unsaturated groups." By Thomas Percy Hilditch.

(Trans., 1908, 1388.)

The *brucine* and *cinchonine* salts of anthranilic and salicylic acids, and of the acetyl and benzoyl derivatives of these acids, have been prepared and measured polarimetrically, and it is found that, in general, as the number of contiguous unsaturated groups increases, the effect on the optical rotatory power of the alkaloids also increases. Further evidence has been obtained as to the effect on the optical activity of a compound when two unsaturated groups are situated at varying degrees of proximity to each other in the molecule.

167. "The constitution of glucose derivatives. Part I. Glucoseanilide, -oxime, and -hydrazone." By James Colquhoun Irvine and Robert Gilmour. (Trans., 1908, 1429.)

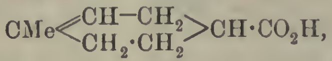
The behaviour of some glucose derivatives on methylation has been studied with a view to distinguishing between compounds produced from the aldehydic form of the sugar and those derived from the γ-oxidic isomerides. Glucoseanilide, when fully alkylated by the silver oxide reaction, is converted into tetramethyl glucoseanilide (m. p. 132—134°), identical in every respect with the compound previously obtained by condensing tetramethyl glucose with aniline. This result shows that glucoseanilide only contains four hydroxyl groups capable of methylation, and that the compound possesses the γ-oxidic linking characteristic of reducing sugars and glucosides. The compound should thus exist in two stereoisomeric forms (α- and β-), and evidence has been obtained that this is the case. When prepared by condensing glucose and aniline at +6°, a dextrorotatory variety is formed, which, in solution, is converted into the lævorotatory α-isomeride $(\alpha_D^{20} - 52\cdot3^\circ)$, thus giving rise to extensive mutarotation. The same phenomenon has also been observed in the case of tetramethyl glucoseanilide in methyl-alcoholic solution.

Glucoseoxime behaves similarly towards the alkylating mixture of silver oxide and methyl iodide, as pentamethyl glucoseoxime was obtained as the product of maximum methoxyl content. This compound is tetramethyl glucoseoxime methyl ether, as by hydrolysis tetramethyl glucose is produced. From this result, it is deduced that glucoseoxime, in addition to reacting as a normal oxime, is equally capable of behaving as a γ-oxide.

Similar methods when applied to glucosephenylhydrazone, led to no definite result, owing to extensive oxidation taking place.

168. "The *cis*- and *trans*-modifications of 1-methyl*cyclo*hexan-2-ol-4-carboxylic acid, and their conversion into 1-methyl-Δ^1-*cyclo*hexene-4-carboxylic acid." By Andrew Norman Meldrum and William Henry Perkin, jun. (Trans., 1908, 1416.)

The authors have reduced 2-hydroxy-*p*-toluic acid by sodium and alcohol, and find that the product of reduction is readily converted into 1-*methyl*-Δ^1-cyclo*hexene*-4-*carboxylic acid*.



$$\mathrm{CMe}{<}\begin{matrix}\mathrm{CH{-}CH_2}\\ \mathrm{CH_2{\cdot}CH_2}\end{matrix}{>}\mathrm{CH{\cdot}CO_2H},$$

by treatment first with hydrobromic acid and then with diethylaniline.

169. "Studies on the viscosity and conductivities of some aqueous solutions. Part I. Solutions of sucrose, hydrogen chloride, and lithium chloride." By W. Heber Green.

The viscosity of sucrose solutions at 18° and 25°, the viscosity and conductivity of hydrochloric acid at 25°, and of lithium chloride solutions at 18° and 25°, have been measured over ranges of concentration limited only by the solubilities of each substance.

The densities of lithium chloride solutions have been re-determined and compared with the results obtained by previous observers.

The viscosity results obtained show that various formulæ which have been suggested do not at all accurately represent the connexion between viscosity and concentration, especially when concentrated solutions are examined. The most concordant result was obtained by using an expression of the form $\eta/\eta_0 = A^{v/w}$, where v = volume of solute, and w = volume of solvent, present per unit-volume of solution.

170. "Studies on the viscosity and conductivity of some aqueous solutions. Part II. Mixtures of solutions of sucrose and lithium chloride; a contribution towards the elucidation of the connexion between ionic mobility and the fluidity of the solution." By W. Heber Green.

The conductivity and viscosity of aqueous solutions have been measured at 25° of three series of mixtures of lithium chloride and sucrose, in which the ratio of the number of lithium chloride molecules to the number of sucrose molecules was 1 : 0·2, 1 : 2·0, and 1 : 20 respectively.

By extrapolation from the results for these mixtures the conductivity and viscosity values have been calculated for a series in which the above ratio was 1 : ∞. In this way the variations in the ionic mobilities at infinite dilution of the salt, concomitant with change of fluidity due to the presence of sugar in solution, were rendered free from some, if not all, disturbing factors.

The curves obtained show that the ionic mobility is not simply proportional to the physical fluidity of the solution, but more nearly to the two-thirds power in the case of lithium chloride and sucrose; with other ions, and other molecules giving rise to viscosity, the exact function varies, and presumably depends on the relative molecular sizes.

With reference to Hartley, Thomas, and Applebey's use of pyridine as an agent for producing viscosity, the author maintains that Stokes' theorem does not hold for a body of molecular size migrating through a medium composed of bodies comparable in size to itself, and, further, that there is no direct evidence for the presence of an aqueous envelope permanently attached to each ion.

No trustworthy method has as yet been established whereby the true ionisation coefficients of a salt can be determined except in solutions of extreme dilution.

171. "The reduction of refractory oxides by carbon."

By Harold Cecil Greenwood. (Trans., 1908, 1483.)

A method has been devised for measuring with an accuracy of about ± 10° the temperatures of reduction of oxides by carbon, the apparatus being suitable for use up to at least 2000°. The reduction temperatures of the oxides of chromium, manganese, uranium, silicon, tungsten, zirconium, and thorium have been measured, and are all found to be far below those previously estimated.

Commencement of the reaction occurs sharply, but the progress of the reduction depends greatly on the intimacy of admixture. The nature of the carbon employed, as also the physical condition of the oxide, exerts a marked influence on the temperature of reduction.

The reactions, so far as the oxides mentioned above are concerned, are found to occur directly between the carbon and the oxide, and are not due to thermal dissociation.

172. "The production of ferro-alloys." By Harold Cecil Greenwood. (Trans., 1908, 1496.)

This investigation is an extension of the work described in the preceding paper. In the case of some of the oxides studied, for example, silica and manganous oxide, it is found that a "catalytic" facilitation of the reduction takes place when metals such as iron, manganese, and copper are present. This confirms observations made in the technical preparation of ferro-alloys under conditions which are unsuitable for the isolation of the pure metal. The lowering of the reduction temperature appears to be due to mutual chemical affinity of the two metals, and also in some cases to the alloy being more fusible than the refractory metal; no evidence is forthcoming to show that reduction is assisted by the heat of reaction of ferric oxide and carbon when this oxide is added instead of metallic iron.

173. "The rapid electroanalytical deposition and separation of metals. Part II. Antimony and tin. The employment of a diaphragm." By Henry Julius Salomon Sand. (Trans., 1908, 1572.)

By means of the apparatus already described, antimony has been estimated in sulphuric acid solutions and suspensions in the presence of hydrazine sulphate, and also in solutions containing chlorides. A high temperature is maintained, and the potential of the cathode is kept under control.

Tin has been deposited from stannic solutions containing a small amount of free sulphuric acid and a sufficiency of oxalic acid at a temperature near the boiling point.

Antimony has been separated from tin. Any *b*-stannic acid which may be present must first be converted into the *a*-form. The electrolyte consists of equal volumes of sulphuric acid and water; a small amount of hydrazine sulphate is added, and the temperature maintained at a little above 100°. The maximum auxiliary voltage is 0·65.

The tin is determined electrolytically in the remaining liquid after neutralisation with ammonia and the addition of oxalic acid. After the greater part of the metal has been deposited, it is necessary to add hydrochloric acid and hydroxylamine hydrochloride in order that the electrolyte may be exhausted; a high temperature is maintained. A considerable number of analyses have been carried out in which the combined metals, taken in varying ratios, weighed approximately one gram. The time for the deposition of the antimony was usually about twenty minutes, and that for the tin about eighty minutes.

An apparatus which allows the employment of a diaphragm in rapid electroanalysis has been constructed, and tested in the determination of copper and its separation from iron.

174. "The measurement of a homogeneous chemical change in a gas. (The thermal decomposition of ozone.)" By Herbert Edmund Clarke and David Leonard Chapman.

(Trans., 1908, 1638.)

It has been commonly supposed that slow pyrogenic changes in gases have their seat principally, if not entirely, on the walls of the enclosing vessel. The authors have succeeded in demonstrating that this conclusion is not true in the case of the decomposition of ozone. In vessels of German glass, of which the ratio of surface to volume is not too large, the rate of decomposition of ozone at 100° is independent of the area of the surface of the globe, a fact which proves that the change is a homogeneous one.

175. "The proteins of egg-yolk." By Robert Henry Aders Plimmer.

(Trans., 1908, 1500.)

In addition to the protein, vitellin, which contains one per cent. of phosphorus and which is insoluble in water, egg-yolk contains a second protein, which contains 0·1 per cent. of phosphorus and which is soluble in water and coagulable by heat.

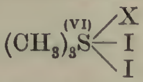
It can be prepared either by extracting the yolks, after treatment with ether, with a large volume of water and heating to boiling in the presence of a small quantity of acetic acid, or by boiling the water used for precipitating the vitellin; this is obtained by dissolving the yolk in 10 per cent. sodium chloride solution, extracting with ether, and precipitating with 20 volumes of water. The second method gives a purer preparation of this protein.

This protein differs from ovalbumin in its content of nitrogen as also in the amounts of the various nitrogen constituents contained in it when determined by Hausmann's method, so that it is not identical with this protein; its behaviour towards ether also indicates this. The various amounts in which the nitrogen constituents are present in the protein are very similar to those in vitellin, and suggests a close relationship between these proteins in egg-yolk; hence the name of *livetin* is suggested for this new protein.

176. "The conductivities of the α-oximino-fatty acids." By John Kenneth Harold Inglis and Lottie Emily Knight. (Trans., 1908, 1595.)

The authors have prepared specimens of the first four of these acids by the action of nitrosulphonic acid on acetoacetic ester and its derivatives. The conductivities agree fairly closely with those measured by Hantzsch and Miolati. Measurements of the conductivities of the sodium salts and comparison of the acids with one another have indicated that the acids are not all of the same configuration, but that oximinopropionic acid is different from the others. The authors have also found evidence of the existence of two forms of α-oximino-butyric and -valeric acids.

177. "Studies of the perhalogen salts. Part II." By Charles Kenneth Tinkler. (Trans., 1908, 1611.)

The formation of periodides has been further investigated by means of the ultra-violet absorption spectra of solutions of iodine containing a halogen salt. The iodine additive compounds of trimethylsulphine iodide, bromide, and chloride, which may be either (I) $(CH_3)_3\overset{(IV)}{S}X\cdot I_2$ or (II)  $(CH_3)_3\overset{(VI)}{S}\begin{array}{l}\diagup X\\ -I\\ \diagdown I\end{array}$ (X = I, Br, or Cl), gave spectra which are identical with those of solutions of iodine containing potassium iodide, bromide, and chloride respectively. This agreement shows that these substances contain the true perhalogen groups, and affords evidence in favour of formula I.

The formation of perbromides (by the addition of a bromide to bromine water) has also been investigated by the spectroscopic method, and evidence obtained of the existence of these substances in a large number of cases. Evidence was also obtained of the formation of bromine additive compounds of chlorides.

178. "The formation of ethers from compounds of the benzoin type." By James Colquhoun Irvine and David McNicoll. (Trans., 1908, 1601.)

The authors find that the methyl ethers of benzoin should always be prepared by the silver oxide reaction, as by the use of Fischer's process of methylation the yields obtained are poorer, and in some instances furan derivatives are formed in quantity. In the case of anisoin, no methyl ether is produced in the latter reaction, which gives rise to the *tetramethoxyl* derivatives of α-methoxy-αβ-dibenzoyldibenzyl (m. p. 218—219°) and of 2-hydroxy-3 : 5-dimethoxytetraphenyltetrahydrofuran (m. p. 263—265°).

The hydrochloric acid method can also be applied to *o*-dimethoxybenzoin only within a limited range of concentration of the acid, as the benzoin readily undergoes molecular rupture to give *o*-methoxybenzoic acid. When the same process is applied to furoin, no methylation takes place, condensation products containing five furyl residues and analogous to those obtained from ordinary benzoin being produced. On the other hand, ethyl ethers of benzoins are comparatively readily prepared by Fischer's method, and no furan derivatives are formed.

In the course of the work, several benzoin ethers have been prepared by the silver oxide method, and the compound described by Limpricht and Jena as "ethyl benzoin" has been examined and shown to be a mixture of hydrobenzoin and *iso*hydrobenzoin.

179. "Aromatic α-disulphones." By Thomas Percy Hilditch.

(Trans., 1908, 1520.)

Aromatic α-disulphones, previously obtained only by the interaction of an aromatic sulphonyl chloride and the sodium salt of an aromatic sulphinic acid, have been prepared in yields varying from 17 to 40 per cent. by the oxidation of sulphinic acids by potassium permanganate in glacial acetic acid solution. *Diphenyl*, *di*-p-*phenetyl*, *di*-p-*tolyl*, and *di*-p-*xylyl α-disulphones* have been thus obtained as well-crystallised, stable substances of high melting point; they are decomposed slowly by strong ammonia into a mixture of sulphonamide and sulphinate, and by warm aqueous potassium hydroxide into the corresponding sulphonates and sulphinates.

180. "The action of bromine on β-hydrindone." By Norman Allen Creeth and Jocelyn Field Thorpe. (Trans., 1908, 1507.)

The bromination of β-hydrindone may be effected by the action of bromine in chloroform solution, all four hydrogen atoms of the hydrindene ring being replaced by the halogen. A *monobromo*- and a *dibromo*-derivative may also be prepared by using the calculated quantity of bromine, but *ααγ*-tribromo-*β*-hydrindone cannot be produced in this way, since, when the amount of bromine required for its formation is employed, an equimolecular mixture of *αγ*-dibromo-*β*-hydrindone and *ααγγ-tetrabromo-β-hydrindone* is alone formed. The monobromo- and dibromo-derivatives are neutral substances insoluble in alkalis, showing, therefore, that the combination of the halogen with the α-carbon atom of β-hydrindone does not transform the compound into a derivative of hydroxyindene. The action of alkalis on the various bromo-derivatives has been investigated, but only in the case of ααγγ-tetrabromo-β-hydrindone has a well-defined product been obtained. In this instance, through a curious fission of the hydrindene ring, the product consists of phthalidecarboxylic acid.

181. "On polymorphism, with especial reference to sodium nitrate and calcium carbonate." By William Barlow and William Jackson Pope. (Trans., 1908, 1528.)

In continuation of their previous work, the authors discuss the relation between the crystalline form and the chemical constitution exhibited in connexion with a number of well-known cases of polymorphism.

182. "The oxidation of phosphorous acid by iodine."

By Bertram Dillon Steele.

In continuation of the investigation of the reaction between iodine and hypophosphorous acid, the velocity of interaction of iodine and phosphorous acid has been studied. It has been found that two reactions of essentially different character occur between these reagents, one of which preponderates in more strongly acid solution, and the other, in the presence of feeble acids, such as acetic and boric acids.

The former of these reactions is catalytically accelerated by the presence of hydrogen ions, and the velocity is proportional to the concentration of phosphorous acid (or of the phosphorous ion) and to the square root of the concentration of the iodine.

The conclusion is drawn that reaction takes place between phosphorous acid molecules (or ions) and iodine atoms, the latter being supplied in extremely small, but sufficient, quantity by the dissociation of the iodine molecules. A slight apparent retardation of the reaction velocity by the iodine is probably due to the incompleteness of the hypothesis which has been suggested to explain the experimental results.

The second reaction, which occurs in the presence of salts, such as sodium acetate, bicarbonate, or biborate, is so complex that the attempt to formulate a hypothesis explanatory of the reaction has been abandoned. The reaction is accelerated by the presence of phosphorous acid and of sodium acetate, and retarded by the presence of iodine and of potassium iodide.

183. "The direct interaction of magnesium and alkyl halides." By James Frederick Spencer and Mary S. Crewdson.

It has been found that all alkyl halides react directly with magnesium. The halides of hydrocarbons lower in the series than butane only react when heated in a sealed tube, but, with the exception of the chlorides, which, so far as has been investigated, appear always to require heating in a sealed tube, all the halides of hydrocarbons higher in the series than butane react with magnesium when the two substances are heated together in a flask. The products are magnesium alkyl halides and hydrocarbons containing twice as many carbon atoms as the original halide. In the reactions taking place in sealed tubes, unsaturated hydrocarbons, of both the acetylene and the olefine series, together with much hydrogen, are also found, in addition to the abovementioned compounds. Methyl bromoacetate also reacts directly with magnesium, giving good yields of methyl acetate and dimethyl succinate, and aromatic chloro-derivatives react with magnesium when heated with it in a sealed tube, yielding the corresponding hydrocarbons in good yield.

184. "The interaction of the metals of the aluminium group and organic halogen derivatives." By James Frederick Spencer and Marion L. Wallace.

Aluminium, indium, and thallium react directly with both aromatic and aliphatic halogen derivatives on heating. In the case of the chloro-derivatives and the lower aliphatic compounds (up to butane), heating in a sealed tube was necessary to bring about the reaction. The formation of an intermediate aluminium organic halide, similar to the Grignard compounds, is the primary result of this interaction, and this compound is decomposed on the addition of water with the production of the parent hydrocarbon and the evolution of much heat. In some cases, the evolution of heat does not take place, and in these cases the parent hydrocarbon is present in the mixture before the addition of water. In all such cases the reactions are extremely slow, it being necessary to heat the substances for twenty-four to thirty hours before the reaction is complete; so that in all probability the intermediate compound is formed and then decomposed by the atmospheric moisture. The indium and thallium reactions, of which only few have been studied, proceed very slowly, as, indeed, do also some of the aluminium reactions, but certain of the latter take place with extreme violence. The yield of hydrocarbons varies from 25 to 75 per cent. of the theoretical. In a few cases, the reaction proceeds along a second line, namely, the formation of a hydrocarbon or derivative containing double the number of carbon atoms as the original substance. The best examples of this are the formation of dimethyl succinate from methyl bromoacetate, and the formation of benzidine from bromoaniline by the action of aluminium. In no case could a reaction between these metals and the halide derivatives be brought about in ethereal solution.

185. "The relation between unsaturation and optical activity. Part IV. The relative influence of bi-, quadri-, and sexavalent sulphur on rotatory power." By Thomas Percy Hilditch. (Trans., 1908, 1618.)

The optical activity of derivatives of *l*-amyl alcohol and *d*-camphor containing sulphur of all the above degrees of valency has been compared, and it has been found that a bi- or quadri-valent sulphur atom has a larger effect on optical rotatory power than saturated sexavalent sulphur, and, also, that the optical anomaly is enhanced by the presence of a second unsaturated group adjacent to the sulphur residue. The maximum change of rotatory power appears to take place when two identical unsaturated groups occur in conjugation, as in the disulphides.

In addition, the study of a series of active salts of corresponding sulphinic and sulphonic acids shows that the sulphonic acid exerts a greater influence on the rotatory power of the base, and this agrees with the effect of unsaturation observed in other cases, on the assumption that the sulphinic salts contain sexavalent sulphur.

186. "Oxidations of hydrocarbons of the benzene series. Part II. Substances containing a negative radicle." By Herbert Drake Law and Frederick Mollwo Perkin. (Trans., 1908, 1633.)

The authors have investigated the oxidation of the nitrotoluenes with chromyl dichloride. Contrary to Étard's statement that quinones are produced, *p*- and *m*-nitrotoluene give good yields of the corresponding aldehydes. With *o*-nitrotoluene, no aldehyde is formed, but a chlorinated compound of no definite boiling point. With *o*-, *m*-, and *p*-chlorotoluenes, the corresponding aldehydes are in all cases obtained. Diphenylmethane yields diphenylcarbinol, and triphenylmethane gives triphenylcarbinol; in both cases in practically theoretical yields. Naphthalene, anthracene, and fluorene were also oxidised, but definite products were not obtained.

187. "Coprosterol. Part I."

By **Charles Dorée** and **John Addyman Gardner.** (Trans., 1908, 1625.)

Having shown that cats and dogs when fed on a raw brain diet produce coprosterol in considerable amount, the authors have studied the action of oxidising and isomerising agents on the substance. Coprosterol is readily oxidised by chromic acid to a ketone, *coprostanone*, which crystallises in leaves melting at 62—63°. The *semicarbazone* melts at 192°, and the *oxime* at 69°. Coprostanone forms with phenylhydrazine a crystalline substance melting at 191°, to which a formula has not yet been assigned. When heated with sodium amyloxide, coprosterol is converted into *ψ-coprosterol*, melting at 119°, and yielding an *acetate*, m. p. 83°, and a *benzoate*, m p. 85°, which differ from the corresponding derivatives of coprosterol. On oxidation with chromic acid, however, it yields the same ketone, coprostanone.

188. "The spontaneous crystallisation of solutions of some alkali nitrates." By **Bernard Mouat Jones.** (Trans., 1908, 1739.)

The author has determined the temperatures of spontaneous crystallisation of supersaturated solutions of the nitrates of potassium, rubidium, and cæsium of various strengths. The method was that used by Hartley, Jones, and Hutchinson (*Trans.*, 1908, **93**, 825) in investigating sodium sulphate solutions. The effect of mechanical friction was studied by introducing fragments of Jena glass into the tubes before sealing. Crystalline fragments, such as garnet, were not used, in order to avoid possible unequal "inoculating" effects on the three solutions. The temperatures at which supersaturated solutions of the salts in question would crystallise spontaneously when slowly cooled and constantly shaken have been recorded. Temperatures corresponding with tubes containing glass fragments lie on regular curves, namely, the supersolubility curves, above which crystallisation cannot take place in the absence of crystal nuclei. Tubes containing no glass fragments generally needed to be cooled into the labile region before crystallisation would occur. The supersolubility curves for potassium and rubidium nitrates run nearly parallel to the solubility curves, approaching the latter as the concentration decreases. For cæsium nitrate, the solubility and supersolubility curves coincide, the metastable region disappearing.

The three corresponding ice-supersolubility curves have been traced, and also the ice-solubility curves for dilute solutions of rubidium and cæsium nitrates. The spontaneous production of the ice phase seems to be a somewhat less definite phenomenon than the production of the salt phase.

Although the order of molecular solubility is rubidium nitrate, potassium nitrate, cæsium nitrate, the order for the sizes of the metastable ranges follows that of the molecular weights, that for potassium nitrate being greatest, and that for cæsium nitrate least. For example, for a concentration of 0·6 gram-mols. of salt to 100 grams of water, the metastable ranges are approximately 4°, 1°, and 0° respectively.

189. "Syntheses with phenol derivatives containing a mobile nitro-group. Part I. The interaction of 2 : 3 : 5-trinitro-4-acetylaminophenol and amines." By Raphael Meldola and James Gordon Hay. (Trans., 1908, 1659.)

The trinitroacetylaminophenol referred to was described by one of the authors in 1906 (*Trans.*, 89, 1935), and its great reactivity, due to the mobility of the 3-nitro-group, indicated in that paper. The compound has now been submitted to further investigation, more especially with reference to the formation of iminazoles from amines. In the present paper, the authors consider the mechanism of the formation of iminazoles in connexion with the conditions that determine the mobility of the nitro-group on the one hand, and, on the other, the nature of the amine with which the trinitro-compound is brought into combination. A quantitative method for determining the yield of iminazole has been devised, and complete series of determinations have been carried out with the isomeric chloroanilines, nitroanilines, and anisidines. The results bring out very clearly the influence of steric hindrance in the case of ortho-substituted amines, the nitro-group being so completely protective that no combination takes place with *o*-nitroaniline. Other series of isomerides are under investigation, and also the products of condensation of secondary amines; dimethylamine and piperidine having been found to react readily, whilst no combination takes place with methylaniline, benzylaniline, diphenylamine, or carbazole. A number of new iminazoles have been prepared, and are described in the paper.

190. "The constituents of the expressed oil of nutmeg." By Frederick Belding Power and Arthur Henry Salway.
(Trans., 1908, 1653.)

Ceylon nutmegs, of good quality, yielded on expression 26·6 per cent. of oil, and when completely extracted with ether, 42·9 per cent.

of oil was obtained. The constants of the expressed oil and of the total fatty acids were as follows:

	Expressed oil.	Total fatty acids.
Melting point	48°	49°
Density, 50°/50°	0·9399	0·9012
Acid value	11·2	218·3
Saponification value	174·6	—
Iodine value	57·8	23·1

The composition of the expressed oil or fat was approximately as follows: Essential oil (12·5 per cent.); trimyristin (73·0 per cent.); oleic acid, as glyceride (3·0 per cent.); linolenic acid, as glyceride (0·5 per cent.); formic, acetic, and cerotic acids (very small amounts); unsaponifiable constituents (8·5 per cent.); resinous material (2·0 per cent.).

The chief unsaponifiable constituent was a new *compound*, $C_{18}H_{22}O_5$, amounting to about 5 per cent. of the expressed oil. It is a yellow, transparent, extremely viscid liquid (b. p. 270—280°/15 mm.), and is devoid of any marked physiological action. The remainder of the unsaponifiable material consisted of myristicin, $C_{11}H_{12}O_3$, with a little phytosterol, $C_{20}H_{34}O$ (m. p. 134—135°).

191. "The preparation of disulphides. Part IV. Esters of dithiodiglycollic and dithiodilactylic acids." By Thomas Slater Price and Douglas Frank Twiss. (Trans., 1908, 1645.)

On submitting the mixture obtained by the interaction of ethyl bromoacetate and sodium thiosulphate in aqueous-alcoholic solution to electrolysis in the cathode compartment of a divided cell, diethyl dithiodiglycollate separates as a heavy oil; from methyl bromoacetate the dimethyl ester is obtained. In a similar manner, the diethyl esters of α-dithio- and β-dithio-dilactylic acids were prepared from ethyl α-bromopropionate and ethyl β-iodopropionate respectively. These esters are all fairly mobile liquids, heavier than water, and possessing a peculiar odour which is not very disagreeable, and not at all like that which is usually associated with the liquid mercaptans and disulphides. The boiling points of these esters are as follows: *dimethyl dithiodiglycollate*, 154°/14 mm.; *diethyl dithiodiglycollate*, 164°/14 mm.; *diethyl α-dithiodilactylate*, 159°/14 mm.; *diethyl β-dithiodilactylate*, 194°/17 mm.

For complete identification of these esters, the corresponding acids were prepared from them by hydrolysis with hydrochloric acid. The properties of the acids obtained agreed with those found by previous observers.

192. "Contributions to the chemistry of the cholesterol group. Part I. The action of hydrogen peroxide and of fused potassium hydroxide on cholesterol." By Robert Howson Pickard and Joseph Yates. (Trans., 1908, 1678.)

A detailed account of work, of which a preliminary account has already appeared (this vol., 121).

193. "Derivatives of *S*-phenylphenazothionium. Part II." By Samuel Smiles and Thomas Percy Hilditch. (Trans., 1908, 1687.)

Further proof of the constitution of these substances is now offered from a general standpoint. Condensation of phenol with di-*p*-nitrodiphenylamine sulphoxide yields the sulphates of two isomeric *S*-hydroxyphenylphenazothionium bases, which are distinguished by their different solubilities and colours in various media. The reduction products of the dinitro-*S*-phenetyl and -hydroxyphenyl derivatives have also been prepared; these on oxidation yield blue dyestuffs similar to thionine. *iso*Dinitrodiphenylamine sulphoxide yields similar derivatives, which are distinguished from those of the di-*p*-nitro-series by greater solubility and absence of fluorescence.

194. "The trithionates and tetrathionates of the alkali metals. Part I." By John Edwin Mackenzie and Hugh Marshall. (Trans., 1908, 1726.)

The authors have prepared a number of tetrathionates from persulphates and thiosulphates (compare Marshall, *J. Soc. Chem. Ind.*, 1897, **16**, 396), thus: $2SrS_2O_3 + K_2S_2O_8 = K_2S_4O_6 + 2SrSO_4$, and of trithionates by removal of sulphur, thus: $K_2S_4O_6 + K_2SO_3 = K_2S_3O_6 + K_2S_2O_3$. The crystallographic details of some of the salts are as follows:

Potassium trithionate, $K_2S_3O_6$. Rhombic, bipyramidal. $a : b : c = 0{\cdot}7168 : 1 : 0{\cdot}4193$. Refractive indices: $\alpha = 1{\cdot}4925$, $\beta = 1{\cdot}5646$, $\gamma = 1{\cdot}6014$. Calculated axial angle, $2V = 68°15'$. Density, 2·336. Molecular volume, 115·8.

Rubidium trithionate, $Rb_2S_3O_6$; isomorphous with the above. $a : b : c = 0{\cdot}7058 : 1 : 1{\cdot}04176$. Refractive indices: $\alpha = 1{\cdot}4874$, $\beta = 1{\cdot}5580$, $\gamma = 1{\cdot}5867$. Calculated axial angle, $2V = 62°23'$. Density, 2·845. Molecular volume, 127·7.

Caesium trithionate, $Cs_2S_3O_6$, is not isomorphous with the above. Triclinic. Density greater than 3·326.

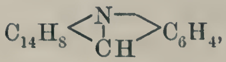
Caesium trithionate monohydrate, $Cs_2S_3O_6,H_2O$. Triclinic. Density, 3·192. Molecular volume, 149·1.

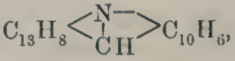
The authors find that rubidium and cæsium can be estimated by conversion into the double sulphate of calcium and the alkali metal.

195. "The synthesis of complex acridines."
By Percy Corlett Austin. (Trans., 1908, 1760.)

The author has applied the methods employed by Senier and himself in the synthesis of various phenonaphthacridines and dinaphthacridines (*Trans.*, 1906, **89**, 1387; 1907, **91**, 1233, 1240; 1908, **93**, 63) to the synthesis of acridines derived from phenanthrene and the closely-allied fluorene. A phenophenanthracridine has also been prepared by the condensation of phenanthraquinone and *o*-nitrobenzyl chloride in the presence of stannous chloride. This is an adaptation of Baezner's reaction (*Ber.*, 1904, **37**, 3077).

Diphenanthracridine, $C_{14}H_8<\substack{N\\|\\CH}>C_{14}H_8$, is a yellow, crystalline substance, insoluble in most solvents; it can be distilled under diminished pressure, and recrystallised from nitrobenzene. Its melting point is above 320°.

Phenophenanthracridine,  $C_{14}H_8<\substack{N\\|\\CH}>C_6H_4$, is prepared by treating an alcoholic solution of a mixture of phenanthraquinone and stannous chloride with *o*-nitrobenzyl chloride. After distillation under diminished pressure, it crystallises from benzene in yellow crystals, melting at 204°.

Fluorene-$\substack{N\cdot\alpha\\|\\CH\cdot\beta}$-*naphthacridine*,  $C_{13}H_8<\substack{N\\|\\CH}>C_{10}H_6$, is prepared from 2-aminofluorene and *a*-naphthol by the action of methylene di-iodide. After distillation under diminished pressure and recrystallisation from toluene, it melts at 259°.

A brown powder is also obtained by the action of methylene di-iodide on 2-aminofluorene, but no method was found for the purification of this substance.

196. "A reaction distinguishing phosphoprotein from nucleoprotein, and the distribution of phosphoproteins in tissues." By Robert Henry Aders Plimmer and Frederick Hughes Scott. (Trans., 1908, 1699.)

In 1906, Plimmer and Bayliss (*J. Physiol*, **33**, 439) found that the phosphorus of caseinogen was completely eliminated as phosphoric acid by the action of one per cent. aqueous sodium hydroxide at 37° in twenty-four hours.

The phosphorus of vitellin, the other well-defined phosphoprotein, is eliminated as phosphoric acid under the same conditions, but the phosphorus of nucleic acid, lecithin, and glycerophosphoric acid, the other phosphorus-containing substances in the tissues, is not separated in this way.

The reaction thus serves as a simple means of distinguishing phosphoproteins from nucleoproteins, and it permits of the determination of the presence of phosphoproteins which are stated to occur in various tissues.

As phosphates are present in all tissues, the reaction cannot be applied directly, but by first extracting the fats and lecithin with alcohol and ether, dissolving out the phosphates from the coagulated protein with water acidified with hydrochloric acid, and then treating it with one per cent. aqueous sodium hydroxide at 37°, the presence of phosphoprotein can be demonstrated. By this procedure, a determination of the amount of the various kinds of phosphorus compounds in the tissues can also be made.

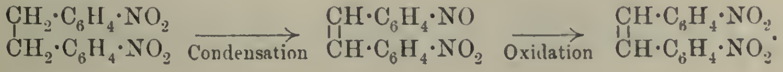
The pancreas alone of the tissues examined contained phosphoprotein, the amount of phosphorus present in this form being about 3 per cent. of the total phosphorus.

Ichthulin, the protein contained in caviar, the eggs of the sturgeon, is described as a phosphoprotein. Its nature has been confirmed by this method, and phosphoproteins have also been found in the eggs of the herring and mullet.

The principal distribution of phosphoproteins is thus in those substances which form the food-stuffs of the embryo bird and fish and the young mammal.

197. "The colouring matters of the stilbene group. Part V. The action of caustic alkalis on derivatives of para-nitrotoluene." By Arthur George Green and James Baddiley. (Trans., 1908, 1721.)

Derivatives of *p*-nitrotoluene containing as ortho-substituent electropositive or weakly electronegative groups (CH_3, OMe, or CO_2H), react least readily with caustic alkalis, giving red intermediate compounds, and on oxidation, derivatives of dinitrodibenzyl. By carrying the combined condensation and oxidation further, the dinitrodibenzyl derivatives are finally converted into dinitrostilbene derivatives, apparently by intermediate formation of nitronitrosostilbenes:



$$\begin{array}{l} CH_2\cdot C_6H_4\cdot NO_2 \\ | \\ CH_2\cdot C_6H_4\cdot NO_2 \end{array} \xrightarrow[\text{Condensation}]{} \begin{array}{l} CH\cdot C_6H_4\cdot NO \\ \| \\ CH\cdot C_6H_4\cdot NO_2 \end{array} \xrightarrow[\text{Oxidation}]{} \begin{array}{l} CH\cdot C_6H_4\cdot NO_2 \\ \| \\ CH\cdot C_6H_4\cdot NO_2 \end{array}.$$

On the other hand, 2 : 4-dinitrotoluene, like other derivatives of *p*-nitrotoluene with a strongly electro-negative ortho-substituent (CN, SO_3Ph, &c.), is far more reactive, giving an excessively unstable blue intermediate product, which is oxidised to tetranitrostilbene without the formation of any dibenzyl compound. The conclusion is drawn that the red intermediate products are nitronitrosodibenzyl derivatives, whilst the blue intermediate compounds are dinitrosostilbene derivatives, both classes of nitroso-compounds existing in an alkaline solution in the form of quinonoid alkali salts.

4 : 4′-*Dinitro*-2 : 2′-*dimethylstilbene*, obtained from *p*-nitro-*o*-xylene, forms yellow needles, which melt at 288—290°. 4 : 4′-*Dinitro*-2 : 2′-*dimethoxystilbene*, prepared from *p*-nitro-*o*-cresol methyl ether, crystallises in orange needles, melting at 268—269°. 4 : 4′-*Dinitrostilbene*-2 : 2′-*dicarboxylic acid*, obtained from nitro-*o*-toluic acid, crystallises from cresol in pale yellow crystals, which melt and decompose at 288—291°. 2 : 4 : 2′ : 4′-Tetranitrostilbene is formed by the action of cold alcoholic potash and iodine on 2 : 4-dinitrotoluene. 2 : 4 : 2′ : 4′-Tetra-aminostilbene forms pale yellow leaflets, which melt at 183—186° (Echales, *Ber.*, 1904, **37**, 3599, gives 191° or below).

198. "The solubility of lime in water."

By Gerald Tattersall Moody and Lewis Thomas Leyson.

The widely divergent numbers giving the solubility of lime in water recorded by previous observers are to be ascribed to the use of impure lime and to faulty methods of determining the solubility. The observed difference in the solubility of lime obtained from different sources is not ascribable to any peculiarity of the lime itself, but is due to the presence of impurities which either affect the solubility of the lime or are capable of neutralising acids, thereby causing an error wherever the lime present in solution is estimated by titration with acid.

An apparatus specially devised for eliminating the errors in method made by previous observers has allowed figures showing the solubility of lime between 2° and 80° to be obtained, and it is found that the curve of solubility between 25° and 80° is practically a straight line.

Thursday, October 22nd, 1908, at 8.30 p.m., SIR WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Messrs. H. R. Lyell and C. T. Rutter were formally admitted Fellows of the Society.

The PRESIDENT referred to the loss sustained by the Society through the death, on August 25th, of Professor A. H. Becquerel, who was elected an Honorary and Foreign Member in May, 1904; also of Sir Thomas Stevenson and Mr. Bennett H. Brough, who died on July 27th and October 3rd, respectively.

On the question of admitting women to the Fellowship of the Chemical Society, the PRESIDENT announced that 1,758 voting papers were received before the close of the ballot; of these there were, in favour of admission, 1,094, against admission, 642, neutral, 22. The matter is now receiving the earnest attention of the Council.

The PRESIDENT further stated that he was authorised by the Council to inform the meeting that in all proceedings relating to the admission of women as Fellows, the Honorary Secretaries have throughout acted under the direction of the Council.

Certificates were read for the first time in favour of Messrs.:

Noel Charles Akers, 26, King's Avenue, Muswell Hill, N.
Maurice Barrett, Holly Bush, Headingley, Leeds.
Robert Bickerstaffe, Chilterns, Wooburn Green, Bucks.
William Sudderick Brakes, 137, Steade Road, Sheffield.
Leonard Clement, B.A., Beamsley, Fairhaven, near Lytham.
Robert Charles Cowley, College of Pharmacy and Chemistry, Brisbane.
Hugh Cecil Duckworth, 66, Victoria Street, S.W.
Horace Barratt Dunnicliff, B.A., B.Sc., 39, Herne Hill, S.E.
Reginald Freeman Easton, 38, Edith Road, W. Kensington.
Henry Fairburn, Northallerton.
Arthur Frank Girvan, B.Sc., 8, Chatsworth Road, West Norwood, S.E.
John Henry Albert Hebron, B.Sc., 9, Buller Street, Derby.
Grove Johnson, 124, Savoy Court, Strand, W.C.
Patrick Anderson Keiller, B.Sc., Colombo, Ceylon.
Frank William Linch, 9, Gladstone Avenue, Manor Park, London, E.
Arthur Stanley Lindley, Prince Building, Medows Street, Bombay.
Edward Pigott Minett, M.D., M.R.C.S., L.R.C.P., Guy's Hospital, S.E.
Cyril Lawrence Norman, 36, Halesworth Road, Lewisham, S.E.
Alexander Robert Normand, M.A., B.Sc., Wilson College, Bombay.

Alexander Rennie, Johannesburg, Transvaal.
Ezra Lobb Rhead, Stonycroft, Polygon Avenue, Levenshulme.
Maurice Salamon Salamon, 64, Oxford Gardens, N. Kensington, W.
William Saunderson, B.Sc., The Armidale School, Armidale, N.S.W.
Ernest Sommerfeldt, Ph.D., The University, Tübingen.
Francis George Henry Tate, Kilmersdon, Homecroft Road, Sydenham, S.E.
Robert Dickie Watt, M.A., B.Sc., P.O. Box 434, Pretoria, Transvaal.
Arthur Weighell, Prince Building, Medows Street, Fort, Bombay.
Frederick Williams, B.A., Bute Villa, Aberdare, South Wales.
William George Winterson, B.Sc., 89, Salisbury Road, Barnet.
Allister MacLean Wright, P.O. Box 617, Christchurch, New Zealand.

Of the following papers, those marked * were read :

***199. "The relationship of colour and fluorescence to constitution. Part II. Rhodamines of mellitic acid." By Oswald Silberrad and Charles Smart Roy.**

Condensation products of mellitic acid with *m*-aminophenol and dimethyl-*m*-aminophenol were described.

The results confirm the conclusions arrived at in the previous paper by one of the authors (Silberrad, *Trans.*, 1906, **89**, 1788), in indicating that a quinonoid structure is not an essential integral part of intensely coloured and fluorescent compounds.

The work also appears to show that the lactone ring is much more stable in these compounds than in the less complex phthaleins already known. As in the case of resorcinol compounds (*loc. cit.*), the tetra-aminodixanthyl derivatives exist in two modifications, in which the xanthyl groups are in the meta- and para-positions with regard to one another respectively. The orientation of these groups was determined by the introduction of a third xanthyl group in the case of the meta-compounds.

As both these still contain carboxylic groups in the ortho-position with respect to one another, the formation of trixanthyl derivatives from the meta-compounds only affords an exceptionally good example of steric hindrance.

The following new compounds, together with their salts and derivatives, were described :

Monoxanthyl derivatives.—3 : 6-*Diamino-9-hydroxyxanthylbenzene-2-carboxylactone* 3 : 4 : 5 : 6-*tetracarboxylic acid.* *Tetramethyl*-3 : 6-*diamino-9-hydroxyxanthylbenzenepentacarboxylic acid* and its *pentaethyl ester.* *Tetraethyl*-3 : 6-*diamino-9-hydroxyxanthylbenzenepentacarboxylic acid.*

Dixanthyl derivatives.—Octamethyl-3 : 3′ : 6 : 6′-*tetra-amino*-9 : 9′-*dihydroxy*-m-*dixanthylbenzene*-2 : 4 : 5 : 6-*tetracarboxylic acid* and its *ethyl* and *benzyl* esters. *Octaethyl*-3 : 3′ : 6 : 6′-*tetra-amino*-9 : 9′-*dihydroxy*-p-*dixanthylbenzene*-2 : 3 : 5 : 6-*tetracarboxylic acid* and its *ethyl* ester. *Tetramethyl*-3 : 6-*diaminotetraethyl*-3′ : 6′-*diamino*-9 : 9′-*dihydroxy*-m-*dixanthylbenzene*-2 : 4 : 5 : 6-*tetracarboxylic acid. Octaethyl*-3 : 3′ : 6 : 6′-*tetra-amino*-9 : 9′-*dihydroxy*-p-*dixanthylbenzene*-2 : 3 : 5 : 6-*tetracarboxylic acid.*

Trixanthyl derivatives.—Hydrated dodecamethyl-3 : 3′ : 3″ : 6 : 6′ : 6″-*hexa-amino*-9 : 9′ : 9″-*trihydroxy*-s-*trixanthylbenzene*-2 : 4 : 6-*tricarboxylactone* and its *triethyl* ester.

DISCUSSION.

Prof. GREEN expressed the opinion that, although the case was more complicated, the facts described by Dr. Silberrad were not greatly different from those which held for the simple rhodamines, and the evidence for or against a quinonoid constitution was of about the same character. The non-formation of a potassium salt was also true of the simple rhodamines, whilst the resistance to esterification might be attributed to steric hindrance, owing to the carboxylic groups being placed between xanthyl residues.

DR. SILBERRAD, in reply, considered that the action of alkalis on the trixanthyl derivatives, and their insolubility even in concentrated potassium hydroxide, must be regarded as strong evidence in favour of the lactonic formula. The mono- and di-xanthyl compounds, which were shown to be inner salts, possessed the properties of strong tetra- and penta-basic acids respectively.

As to the observation that the rhodamines also formed potassium salts only with the utmost difficulty, it seemed to him that this should be regarded as evidence of their lactonic structure rather than as indicative that the trixanthyl derivatives of mellitic acid, which showed the same lactone-like property, possessed a quinonoid structure.

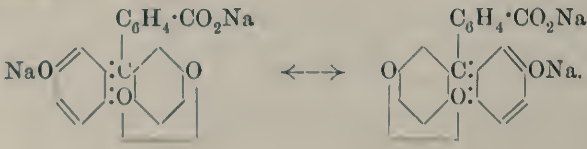
As to the possibility of steric hindrance being the explanation of the difficulty experienced in the esterification of the trixanthyl compounds, here again he thought that the evidence was in favour of the lactonic formula rather than the assumption of any such explanation, for if this were so, the formation of a tetraethyl ester from the meta-dixanthyl derivatives would offer more difficulty than the esterification of the para-compounds; experience showed, however, the converse to be the case, the meta-compound being the more readily esterified.

*200. "Constitution of the salts of the phthaleins and the cause of colour in the triphenylmethane series." By Arthur George Green.

Whilst strong evidence has been adduced in favour of the quinonoid structure of the coloured salts and ethers of the phthaleins, there still remain several facts which are not fully explained. One of these is the remarkable difference in colour between the quinonoid diethyl ethers and the alkali salts (orange in the first case and violet-red in the second), whilst another is the circumstance that the substitution of one only of the phenolic hydroxyl groups by methoxyl, in either phenolphthalein or in quinolphthalein, suffices entirely to prevent the formation of coloured salts with alkalis.

By an extension of von Baeyer's theory of oscillatory quinonoid bonds, employing the usual Fittig formula for quinonoid compounds instead of the Graebe formula used by von Baeyer, and by the assumption that the movement of the metallic or acid ion between the two salt-forming groups is the determining cause of the quinonoid oscillation, a satisfactory explanation can be given of the above and other facts, such as the effect of salt formation on colour intensity, the function of auxochromic groups, and the increase of basicity according to the "power law." An explanation is also afforded of the observation that the behaviour of dimethylanilinephthalein, the basic analogue of phenolphthalein, towards acids is analogous to that of the latter towards alkalis, these compounds giving under specific conditions a deep violet colour readily destroyed by an excess of the reagent.

In the quinolphthalein series, the possibility of a meta-quinonoid structure for the coloured alkali salts as suggested by R. Meyer was discussed in relation to the recent work of Green and King. The conclusion was drawn that the facts are best explained by the assumption of an ortho-quinonoid linking oscillating between the two benzene nuclei:



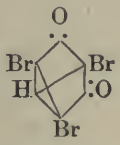
Discussion.

Dr. Silberrad suggested that it would be a fuller and more complete explanation of the experimental evidence if colour were wholly attributed to some inner molecular oscillation, such as that so well illustrated by the examples considered by Prof. Green, and not to the presence of a quinonoid group at all; thus the ethers of these compounds were almost colourless, yet they still contained the same quinonoid constitution, and differed from the parent compound only in that they could not exhibit inner molecular oscillation.

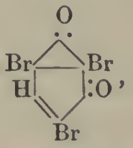
He agreed that the presence or absence of a quinone group exercised considerable influence on the colour of any compound, but so would any other considerable constitutional change.

Further, he thought that the wide application of the quinonoid configuration to coloured compounds by analogy was open to criticism. Prof. Green's observation, that the coloured salts of the rhodamines become colourless in the presence of an excess of acid, did not apply to their mellitic analogues, which yielded coloured solutions with any excess of acid.

Dr. Morgan remarked that R. Meyer and Desamari's recent demonstration of the existence of tribromo-*m*-benzoquinone,



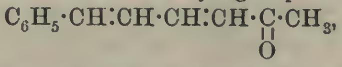
or



afforded important experimental evidence in favour of the view that certain phthaleins might have a meta-quinonoid structure.

In connexion with the theory that the colour of triphenylmethane dyes was associated with an oscillation of the quinonoid phase, it was noteworthy that diphenylnaphthylmethane dyes could be obtained from naphthastyril, a peri- or 1 : 8-derivative of naphthalene, because, owing to the configuration of the 1 : 8-naphthylene residue present in these colouring matters, it was difficult to see how this oscillation would take place.

*201. "The relation between absorption spectra and chemical constitution. Part X. Unsaturated acids of the benzene series." By Edward Charles Cyril Baly and Konrad Schaefer.

The absorption spectra of cinnamylideneacetic, cinnamylidenemalonic, benzylidenemalonic, and cinnamic acids have been examined with a view to determining the influence of substitution of the acidic hydrogen atoms by metals and alkyl groups. In the case of cinnamylideneacetone,  $C_6H_5\cdot CH\colon CH\cdot CH\colon CH\cdot \underset{\underset{O}{\|}}{C}\cdot CH_3$, a strongly marked absorption band is developed, owing to the isorropesis arising from the conjugation of the carbonyl group with the two double linkings and the phenyl group. In cinnamylideneacetic acid, where the methyl group is replaced by hydroxyl, the absorption band is shifted towards the violet, owing to the fact that the free residual affinity of the carbonyl group is decreased by the juxtaposition of the hydroxyl group. This decrease of free residual affinity is most marked in the case of the readily ionised sodium salt, and least marked with the acid when the ionisation is restrained by the addition of hydrogen chloride. This effect has been observed in the four acids mentioned, and is especially marked in the case of cinnamylidenemalonic acid. The addition of alkali to this acid causes a shift of the absorption band from just inside the visible region to just beyond it, so that the free acid appears to be coloured yellow, and its sodium salt appears to be colourless. The results throw some light on the catalytic action of mineral acids on the esterification process.

*202. "Relation between chemical constitution and physiological action in certain substituted aminoalkyl esters." By Frank Lee Pyman.

Several substituted aminoalkyl esters have been prepared with the object of producing a cocaine substitute; none of these, however, are suitable for the purpose, since such as possess anæsthetic properties are also toxic and irritant. These substances were prepared by benzoylating (in two cases, phthaloylating) the corresponding amino-alcohols, two of which, 1 : 4-*diethanolpiperazine* (m. p. 134—135°) and *β-hydroxy-β-*3 : 4-*methylenedioxyphenylethyldimethylamine*,* have not previously been described. The chemical, physical, and physiological properties of the following aminoalkyl esters and their salts have been examined: *dibenzoyloxymethyldiethylamine*, *dibenzoyloxytriethylamine*, *βγ-dibenzoyloxydimethylpropylamine*, *βγ-dibenzoyloxydiethylpropylamine*, *βγ-dibenzoyloxypiperidylpropane* (m. p. 64—65°), *piperidylethyl benzoate*, *s-di-β-benzoyloxy-*1 : 4-*diethylpiperazine* (m. p. 104—105°), *diethylaminoethyl phthalate*, *piperidylethyl phthalate*, *β-benzoyloxy-β-*3 : 4-*methylenedioxyphenylethyldimethylamine*.

203. "The passage of hydrogen through a palladium septum, and the pressure which it produces." By Demetrius Tsakalotos.

It was shown by Sir William Ramsay (*Phil. Mag.*, 1894, [v], 38, 206) that hydrogen, when it passes through the walls of a palladium tube filled with a gas (N_2, CO, CO_2, CN) at atmospheric pressure, raises the pressure in the tube by nearly one atmosphere when the external pressure of the hydrogen is one atmosphere. There is always a small deficit in pressure, however, for the rise in pressure produced by the entry of the hydrogen never attains that of the atmosphere. The amount of this deficit depends on the nature of the gas originally in the tube.

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* Where melting points are not given, the free base did not crystallise.

The experiments to be recorded were made with the object of ascertaining whether, if the tube were initially filled with an indifferent gas, the final pressure would be the theoretical one. Argon was chosen for this purpose. The method employed differed little from that described by Ramsay. The tube was filled with pure dry argon at atmospheric pressure, and at a temperature of 280° (boiling point of bromonaphthalene); it was then exposed on its external surface to an atmosphere of hydrogen, carefully purified and dried. If p be the external pressure of the hydrogen, and p' the internal pressure, that is, the pressure due to the hydrogen after the gas had ceased to enter, the results of the experiments are as follow:

	I.	II.	III.	Theory.
p'/p	0·9281	0·9189	0·9242	1·000

The mean result is 0·9238.

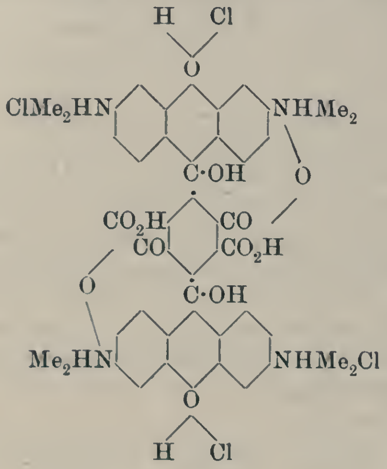
This result does not appreciably differ from that previously obtained by Ramsay; the figures varied between 0·8984 and 0·9693.

204. "Constitution of the phthaleins of mellitic and pyromellitic acids." By Oswald Silberrad.

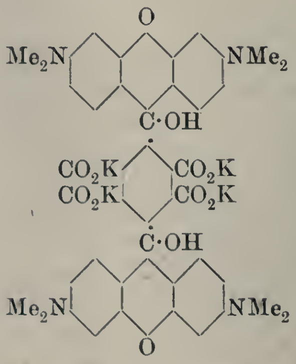
In a previous paper, the author described (*Trans.*, 1906, **89**, 1789) condensation products of mellitic and pyromellitic acids with resorcinol to which were assigned carbinol formulæ, as being the most in accord with observed facts. Subsequently, quinonoid formulæ have been suggested (compare Green, *Proc.*, 1907, **23**, 12).

In considering the possibility of so formulating these compounds, it should not be lost sight of that the necessity for attributing quadrivalency to the pyrone oxygen atom is hardly in accord with the properties of the compounds in question; they show none of the basic properties generally attributed to this element when so linked; on the contrary, they form salts up to the full basicity of the acid groups present. Further, recent work by the author has shown that when present in analogous compounds a quadrivalent oxygen atom impresses a strongly basic influence on the specific properties of the compound.

Thus it has been shown that octamethyltetra-aminodixanthylbenzenetetracarboxylic acid can behave as a base, forming a tetrahydro-chloride (I), or as an acid, forming a tetrapotassium salt (II), according as the pyrone oxygen is quadrivalent or not.



(I.)



(II.)

205. "A new form of gas burette." By Arthur Edwin Hill.

A novel form of gas burette was described which consists of a series of ten bulbs, each with a capacity of 10 c.c., connected by short, narrow, graduated tubes. Fractional parts of 10 c.c. are measured in a narrow, side-tube, which has a capacity of 10 c.c. graduated into twentieths of a c.c.; this is connected to the main vessel by a capillary tube, and forms one arm of a U-shaped manometer, which indicates the pressure of the gas inside the burette. The apparatus is provided with a capillary tap at each end, and is connected by flexible rubber tube with a levelling reservoir.

206. "A molecular compound of trinitroacetylaminophenol and β-naphthol." By Raphael Meldola and James Gordon Hay.

The 2 : 3 : 5-trinitro-4-acetylaminophenol described by one of the authors in a former paper (*Trans.*, 1906, **89**, 1935) combines readily with β-naphthol when solutions containing equimolecular weights of the two compounds are mixed together and boiled for a few minutes. Acetic acid or alcohol can be used as a solvent. If the solution is not too dilute, the molecular compound separates out on cooling in dense, red prisms, melting with decomposition at 184—185° :

0·1196 gave 0·2216 CO_2 and 0·0392 H_2O. C = 50·33 ; H = 3·6.
0·0895 „ 9·9 c.c. N_2 (moist) at 14·5° and 755·8 mm. N = 12·89.
0·1245 „ 13·5 „ „ „ 10° „ 752·3 „ N = 12·85.
$C_8H_6O_8N_4,C_{10}H_8O$ requires C = 50·2 ; H = 3·23 ; N = 13·02 per cent.

That the compound is "molecular" is shown by its behaviour towards reagents. By alkali alone it is dissolved with an orange colour, which gradually disappears on standing, and, on acidifying, the solution yields only the products of decomposition of trinitroacetylaminophenol and β-naphthol. With alkali and dimethyl sulphate, the compound gives β-naphthyl methyl ether and the products of decomposition of the trinitroacetylaminophenol. By continued crystallisation from acetic acid, the compound is gradually resolved into its components.

The formation of this molecular compound is of interest as, so far, β-naphthol is the only phenol which has been found to enter into combination with the trinitro-compound. The latter, unlike picric acid and other polynitro-compounds, does not appear to form molecular compounds with hydrocarbons. This point is, however, still undergoing investigation, and the authors communicate this note as a preliminary statement of the results of their experiments.

207. "The products of reduction of azoxybenzene." (Preliminary note.) By Leslie Hamilton Berry.

The author is unable to confirm the statement of Schmidt and Schultz (*Ber.*, 1879, **12**, 484), that stannous chloride and hydrochloric acid reduce azoxybenzene to aniline, very little benzidine being formed.

He finds, on the contrary, that in no case is the yield of aniline more than 35 per cent., and the principal product is benzidine.

208. "The chlorination of para-nitroaniline."
By Bernhard Flürscheim.

Hitherto no satisfactory method for introducing two atoms of chlorine into *p*-nitroaniline has been known. More especially by the action of chlorine gas much resinous matter was formed. The author finds, however, that a quantitative yield of pure dichloro-*p*-nitroaniline is obtained when *p*-nitroaniline is chlorinated in a mixture of acetic and mineral acids at a low temperature ; this result is in accordance with theoretical deduction.

209. "Syntheses with the aid of monochloromethyl ether. Part I. The action of monochloromethyl ether on the sodium derivatives of ethyl malonate and ethyl *iso*propylmalonate." By John Lionel Simonsen.

Monochloromethyl ether and ethyl sodiomalonate readily condense with the formation of *ethyl β-methoxymethylmalonate*:

$$\mathrm{MeO{\cdot}CH_2Cl + CHNa(CO_2Et)_2 \longrightarrow MeO{\cdot}CH_2{\cdot}CH(CO_2Et)_2};$$

this is a colourless oil, which boils at 121—122°/15 mm. When hydrolysed with hydrochloric acid, it is converted into *cis-cyclo*butane-1:3-dicarboxylic acid. Other derivatives of ethyl β-methoxymethylmalonate have also been prepared.

When monochloromethyl ether and ethyl *iso*propylsodiomalonate are condensed, *ethyl β-methoxymethyl*iso*propylmalonate* is formed:

$$\mathrm{MeO{\cdot}CH_2Cl + CNa(CHMe_2)(CO_2Et)_2 \longrightarrow MeO{\cdot}CH_2{\cdot}C(CHMe_2)(CO_2Et)_2}.$$

This substance boils at 130—132°/20 mm., and, on hydrolysis, yields *β-methoxymethyl*iso*propylmalonic acid*, which crystallises in plates, melting at 83—84°.

210. "The effect of constitution on the rotatory power of optically active nitrogen compounds. Part III." By Reginald William Everatt and Humphrey Owen Jones.

An account was given of the resolution of *p*-tolylbenzylmethylallylammonium hydrogen tartrate. The corresponding iodide has been prepared by Wedekind (1903), who found that the camphorsulphonate could not be resolved. This compound is of interest, since it contains two groups, benzyl and tolyl, which have the same mass. The salt of the lævorotatory base was isolated by crystallising about thirteen times from alcohol and ether.

The molecular rotatory power of the ion at 15° is −246°, that of the iodide in alcohol is −257°, and in chloroform is −267°.

The rotatory power of the ion is greater than that of the ion of the corresponding phenyl (167°) or *p*-bromophenyl compound (191°). This is not in agreement with the requirements of Guye's hypothesis as applied to the case of nitrogen, and shows that the constitution of a group may exert such a marked effect on the rotatory power of a compound as to veil completely the effect of mass.

211. "Studies on the cobaltinitrites."
By Mary Cunningham and Frederick Mollwo Perkin.

On adding a solution of a salt of a primary amine to a strong solution of sodium cobaltinitrite, a yellow or orange precipitate is produced, which is frequently crystalline. If the solution is not kept cold, the product is apt to decompose. Analysis shows that three molecules of the amine combine with the cobaltinitrite residue. Thus the compound obtained from methylamine has the formula

$$(CH_3 \cdot NH_3)_3Co(NO_2)_6.$$

The authors have prepared the methylamine, ethylamine, aniline, *m*- and *p*-bromoaniline, and the *p*-toluidine compounds, all of which have been analysed. It is found that, unless carefully dried as soon as prepared, the compounds are extremely unstable, and even then it is necessary to analyse them very soon after preparation. Diethylamine also forms a crystalline compound, $[(C_2H_5)_2NH_2]_3Co(NO_2)_6$, which is fairly stable. The methylaniline compound decomposes before it can be dried, and apparently a nitroso-compound is produced. From dimethylaniline, the *p*-nitroso-derivative is at once formed.

212. "The relation between viscosity and chemical constitution. Part II. The existence of racemic compounds in the liquid state." By Albert Ernest Dunstan and Ferdinand Bernard Thole.

The authors have applied the viscosimetric method to the above problem, and have determined the viscosities at 25° of the active and inactive forms of tartaric acid, malic acid, pinene, camphene, and limonene.

They find that in general the inactive form has the lower viscosity, and argue that this points to the existence as such of the racemic compound in the liquid state.

They have further examined the viscosity of solutions of sodium ammonium tartrate at different temperatures, and find that a change of curvature appears at 28·7°; hence a new method of determining transition points is to be added to those already in vogue.

213. "The formation of polyiodides in nitrobenzene solution. Part IV. The electrolytic dissociation of the polyiodides of the alkali metals and ammonium radicles." By Harry Medforth Dawson and Colin Gyrth Jackson.

The authors have investigated the electrolytic dissociation of the polyiodides in nitrobenzene solution by means of freezing-point and electrical conductivity measurements. The data obtained show that the polyiodides are ionised to a considerable extent.

In the case of the polyiodides of potassium, for which several series of freezing-point measurements were made, the depressions, calculated from the chemical dissociation on the assumption that the higher polyiodides are ionised to the same extent as the tri-iodide, are in good agreement with the observed values. It is probable that the penta-, hepta-, and ennea-iodide of each alkali metal and ammonium base are equally ionised, although the degree of ionisation appears to vary with the nature of the cation. On the other hand, evidence has been obtained that, in some cases, the tri-iodides are not ionised to the same extent as the higher polyiodides.

As the result of comparative measurements of the conductivity of solutions of the iodides and tri-iodides, it is found that the tri-iodides are electrolytically dissociated to a much greater extent than the iodides. In the case of tetrapropylammonium iodide, for which, on account of its solubility in nitrobenzene, a comparison by the freezing-point method has been possible, the conclusions drawn from the conductivity data are completely confirmed.

The mobilities of the polyiodide ions have been deduced by combining the results of transport measurements with the freezing-point and conductivity data.

Finally, determinations of the molecular solution-volume of iodine and the polyiodides have been made. The results show that the volume of combined iodine differs from that of iodine in the free condition.

214. "The direct action of radium on copper and gold." By Edgar Philip Perman.

The direct action of the radiations from a radium salt on a pure copper salt has been investigated; the salts were placed in small capsules facing one another in a wide tube, which was exhausted and sealed.

In the case of gold, the two salts were left in solution together, and in another experiment, gold and radium barium sulphate were precipitated together, thoroughly washed, and allowed to stand.

After four months, no trace of lithium could be detected by spectroscopic examination, and the conclusion is drawn that if any copper or gold is converted into lithium, it cannot be more than the one hundred-millionth part of the weight of the radium salt per day in the case of copper, and the one two-hundred-millionth part in the case of gold, under the conditions of the respective experiments.

215. "The atomic volumes of phosphorus. Part II. Phosphorus and bromine." By Edmund Brydges Rudhall Prideaux.

The specific volumes of liquid phosphorus pentabromide and the pressures of its saturated vapour at various temperatures have been measured. From the values of the vapour pressures from 20° to 100°, and of the coefficients of expansion and molecular volumes from 85° to 100° and 100° to 165°, the true boiling point is placed at 106°, and the molecular volume at this temperature is 157·3. A review of the molecular volumes of the chlorides, bromides, phosphoryl chloride, and phosphoryl dichlorobromide shows that the atomic volumes of tervalent are greater than those of quinquevalent phosphorus.

216. "Isomeric chromous chlorides." By Elizabeth Mary Rich.

The author has devised a rapid and convenient method of preparing pure chromous chloride, which is thus rendered practically available for use in all kinds of gas analysis. Two isomeric series of hydrates and their solutions have been studied. The green isomeride has the formula $CrCl_2,4H_2O$, identical with the blue salt. Its green solution contains the ions $CrCl^{\cdot}$ and Cl'.

217. "The relative atomic weights of hydrogen and chlorine." By Robert Whytlaw Gray and Frank Playfair Burt.

The ratio H : Cl has been measured by a method which is different from that employed by Dixon and Edgar (*Phil. Trans.*, 1905, **205**, 169) or by Noyes and Weber (*J. Amer. Chem. Soc.*, 1908, **30**, 13). The investigation was carried out with hydrogen chloride obtained from several sources, and purified by fractional distillation. (1) The density of the gas was determined, the gas being condensed on charcoal and weighed. The mean of twenty experiments gave for the weight of a normal litre of gas the value 1·63900 ± 0·00004 grams, or making a small correction for the amount of gas condensed on the surface of the walls of the density bulb and absorbed by the tap grease, 1·63885 grams. (2) The gas was analysed volumetrically by passage over heated aluminium. By this means the volume of hydrogen contained in exactly two volumes of hydrogen chloride measured at 0° and 760 mm. was determined, and this gave the exact ratio of the volumes of hydrogen and hydrogen chloride which under standard conditions contain the same number of molecules.

Eight measurements with gas from different sources gave for the volume ratio $\frac{H_2}{HCl}$ the mean value 1·00790 ± 0·00002.

From these two results, the molecular weight of hydrogen chloride may be directly calculated as follows:

If D_{HCl} represents the measured weight of a litre of hydrogen chloride at 0° and 760 mm., lat. 45°, and D_{H_2} represents the known weight of a litre of hydrogen at 0° and 760 mm., lat. 45°, and if $\frac{V_{H_2}}{V_{HCl}}$ expresses the ratio of the volumes of hydrogen and hydrogen chloride, which at 0° and 760 mm. contain the same number of molecules: then the molecular weight of hydrogen chloride is given by the expression $\left(\frac{D_{HCl}}{D_{H_2}} \times \frac{V_{HCl}}{V_{H_2}}\right) \times 2$.

On the basis of Morley's values for the normal density of hydrogen, namely, 0·089873 gram per litre, and for the atomic weight of hydrogen, namely, 1·00762, the molecular weight of hydrogen chloride is $\left(\frac{1{\cdot}63885}{0{\cdot}089873} \times \frac{2}{1{\cdot}00790}\right) 1{\cdot}00762 = 36{\cdot}461$, and the atomic weight of chlorine $= 35{\cdot}453$. This agrees almost exactly with the results of Noyes and Weber, namely, $Cl = 35{\cdot}452$, but is $\frac{1}{3500}$ part lower than Dixon and Edgar's number, namely, 35·462.

218. "The interaction of hydrogen dioxide and sulphides." By Maud Gazdar and Samuel Smiles.

The usual method of preparing sulphoxides from sulphides by means of concentrated nitric acid is useless when applied to sensitive compounds, such as di-*p*-aminophenyl sulphide or thiodiglycollic acid. Hydrogen dioxide in acetone or aqueous solution reacts at the ordinary temperature with the sulphides, giving almost quantitative yields of the corresponding sulphoxide. The reaction can be applied to sulphides of very varied character, for, besides amyl, benzyl, and phenetyl sulphoxides, the hitherto unknown *di*-p-*aminophenyl sulphoxide* and *thionyldiglycollic acid* were obtained. Diphenylene disulphide and tetranitrodiphenyl disulphide are not attacked by the reagent under ordinary conditions.

219. "The influence of solvents on the rotation of optically active compounds. Part XIII. Ethyl tartrate in aromatic nitro-derivatives. Influence of temperature change on rotation in solution." By Thomas Stewart Patterson.

The influence of the aromatic nitro-derivatives as solvents on the rotation of ethyl tartrate was described. The effect of temperature-change on the rotation of these and other solutions was also discussed.

220. "The isomeric menthols." (Preliminary note.) By Robert Howson Pickard and William Oswald Littlebury.

According to theory there should be eight optically active forms of 1-methyl-4-*iso*propyl*cyclo*hexan-3-ol corresponding in pairs with four racemic compounds. Of these menthols, one, the ordinary *l*-menthol, occurs in nature, whilst the existence of others has been indicated by the researches of Beckmann, Kondakoff, and Brunel. It is now found that these compounds can be separated by the fractional crystallisation of suitable esters, such as the hydrogen phthalates, hydrogen succinates, etc.

By the reduction of thymol with hydrogen in the presence of reduced nickel, Brunel (*Compt. rend.*, 1905, **140**, 252) obtained a low-melting thymomenthol, which he considered was transformed into an isomeride by conversion into an ester and subsequent hydrolysis. The authors have been able to show that this "α" thymomenthol of Brunel contains three (or perhaps all four) of the racemic compounds mentioned above. Up to the present, two of these have been fully characterised and resolved into their optically active components by fractional crystallisation of various alkaloidal salts of some of their acid esters (compare Pickard and Littlebury, *Trans.*, 1907, **91**, 1974).

The first of these racemic menthols melts at 25°, and forms a *hydrogen succinate*, m. p. 86°, and also a *hydrogen phthalate*, m. p. 131°, the latter of which by fractional crystallisation of either its cinchonine or brucine salt yields a lævorotatory isomeride. When hydrolysed, this lævo-ester yields a menthol identical in melting point and rotation with the natural menthol.

The second of the racemates melts at 48—50°, and forms a *hydrogen phthalate*, m. p. 175—177°, which is readily resolved into its active components by crystallisation of the brucine salt.

ADDITIONS TO THE LIBRARY.

I. *The following books have been presented to the Library by Mr. A. W. Soward :*

Clarke, *John.* A demonstration of some of the principal sections of Sir Isaac Newton's Principles of Natural Philosophy. In which his peculiar method of treating that useful subject is explained, and applied to some of the chief phænomena of the system of the world. pp. xvi + 313 + vii. London 1730.

Euler, *Leonhard.* Letters of Euler to a German Princess, on different subjects in physics and philosophy. Translated from the French by *Henry* **Hunter**. 2 vols. pp. lxiii + 515, viii + 520 + xxviii. ill. London 1795.

Macbride, *David*. Experimental essays on medical and philosophical subjects: Particularly, I. On the fermentation of alimentary mixtures, and the digestion of the food. II. On the nature and properties of fixed air. III. On the respective powers, and manner of acting, of the different kinds of antiseptics. IV. On the scurvy . . . V. On the dissolvent power of quick-lime; and a further investigation of the properties of fixed air. 2nd edition. pp. xiv + 296. ill. London 1767.

Martin, *Benjamin*. An essay on electricity. pp. 40. London 1746.

——— A panegyrick on the Newtonian philosophy. 2nd edition. pp. 62. London 1754.

——— Microscopium Polydynamicum: or, a new construction of a microscope. pp. 10. ill. London 1771.

——— Thermometrum Magnum: or, grand standard thermometer. Expressing all degrees of heat and cold, from that with which mercury boils, to that which congeals it into solid metal. pp. vi + 10. London 1772.

——— A description of the nature, construction, and use of the Torricellian, or simple barometer. pp. 24. ill. London 1778.

Martine, *George*. Essays on the construction and graduation of thermometers, and on the heating and cooling of bodies. A new edition, with notes and considerable additions, especially the tables of the different scales of heat, exhibited by Dr. Black, in his annual course of chemistry. pp. vi + 186. ill. Edinburgh 1792.

Muspratt, *James Sheridan*. Chemistry, theoretical, practical, and analytical, as applied and relating to the arts and manufactures. Division I. pp. 288 [plates missing]. Glasgow [*no date*].

Nollet, *Jean Antoine*. Leçons de physique expérimentale. 6 vols. [Vols I & II, 3rd edition; Vols. III & V, 2nd edition; Vols. IV & VI, 1st edition.] pp. lviii + 379, 489, 512, 535, vi + 592, 527. ill. Paris 1748—1764.

Vauquelin [*Louis Nicolas*]. Manuel complet de l'essayeur, suivi de l'instruction de Gay-Lussac, sur l'essai des matières d'argent par la voie humide, et des dispositions du laboratoire de la monnaie de Paris; par D'Arcet. Nouvelle edition . . . par *A. D.* **Vergnaud**. pp. 248. ill. Paris 1836.

Violette, *Henry*. Nouvelles manipulations chimiques simplifiées, . . . contenant la description d'appareils simples et nouveaux, suivi d'un cours de chimie pratique à l'aide des instruments. 3rd edition. pp. iv + 476. ill. Paris 1860.

II. *By Purchase.*

Congrès international de chimie appliquée (II). Comptes rendus. 5 vols. pp. 773, 540, 499, 659, 260. ill. Paris 1897. (*Recd.* 10/6/08.)

Post, *Julius.* Chemisch-technische Analyse. Edited by *Bernhard* **Neumann.** Vol. II, part 3. pp. 660 to 1048. ill. Braunschweig 1908. (*Recd.* 11/8/08.)

Priestley, *Joseph.* Experiments and observations on different kinds of air. Vol. I. pp. 324. [Wanting pp. i—xxviii.] London 1774. (*Recd.* 3/6/08.)

Procter, *Henry Richardson.* Leather industries laboratory book of analytical and experimental methods. 2nd edition. pp. xx + 460. ill. London 1908. (*Recd.* 8/8/08.)

Zopf, *W.* Die Flechtenstoffe in chemischer, botanischer, pharmakologischer und technischer Beziehung. pp. xi + 450. ill. Jena 1907. (*Recd.* 27/5/08.)

III. *Pamphlets.*

Hooper, *David.* Fat of the Himalayan Bear. (From the *J. and Proc., Asiatic Soc. of Bengal.* **4**, 1908.)

——— Oil of *Lawsonia alba,* Lamk. (From the *J. and Proc., Asiatic Soc. of Bengal.* **4**, 1908.)

Lucas, *A.* The chemistry of the river Nile. pp. 78. Cairo 1908.

——— A preliminary note on some preservative materials used by the Ancient Egyptians in connection with embalming. (From the *Cairo Scientific Journal.* **2**, 1908.)

Pittman, *E. F.* Problems of the artesian water supply of Australia, with special reference to Professor Gregory's theory. [*Clarke Memorial Lecture delivered before the Royal Society of New South Wales,* 31st October, 1907.] pp. 30. Sydney 1908.

Power, *Frederick B.*, and **Tutin,** *Frank.* Chemical examination of Grindelia, Part II. (From the *Proc. Amer. Pharm. Assoc.* **55**, 1907.)

Reade, *T. Mellard*, and **Holland,** *Philip.* Analyses of Longmyndian Rocks. (From the *Proc. Liverpool Geol. Soc.* 1907—1908.)

York Health and Housing Reform Association. The milk supply of York. pp. 19. York 1908.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 7th, 1908.

All persons who received Grants in December, 1907, or in December of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Tuesday, December 1st.

The Council wish to draw special attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in Inorganic and Metallurgical Chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the Coal-tar and Allied Industries.

At the next Ordinary Meeting, on **Thursday**, November 5th, 1908, at **8.30** p.m., the following papers will be communicated:

"The direct union of carbon and hydrogen." By W. A. Bone and H. F. Coward.

"The relation between absorption spectra and chemical constitution. Part XI. Some aromatic hydrocarbons." By E. C. C. Baly and W. B. Tuck.

"Organic derivatives of silicon. Part VII. Synthesis of *dl*-sulphobenzylethyl*iso*butylsilicyl oxide." By B. D. W. Luff and F. S. Kipping.

"Chlorine derivatives of pyridine. Part IX. Preparation and orientation of the dichloropyridine, m. p. 66—70°." By W. J. Sell.

"Chlorine derivatives of pyridine. Part X. Orientation of the trichloropyridine, m. p. 49—50°." By W. J. Sell.

"Chlorination of methyl derivatives of pyridine. 2-Methylpyridine. Part II." By W. J. Sell.

"The triazo-group. Part V. Resolution of α-triazopropionic acid." By M. O. Forster and H. E. Fierz.

"The triazo-group. Part VI. Triazoethyl alcohol and triazoacetaldehyde." By M. O. Forster and H. E. Fierz.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24 No. 346

Thursday, November 5th, 1908, at 8.30 p.m., SIR WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Mr. G. J. Fowler was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Thomas James Baker, D.Sc., Trebarwith, Chester Road, Erdington, Birmingham.
Charles Everitt, M.A., 67, Boston Avenue, Southend-on-Sea.
Henry Hamilton Green, 36, Princes Square, Regent Park, Glasgow.
Edward Hinks, B.Sc., 23, Tavistock Road, Croydon.
Joseph Kenyon, B.Sc., 6, Cheltenham Street, Blackburn.
Gregor MacGregor, M.A., B.Sc., Giffen Park, Dysart, Fife.
William Herbert Miles, 3, Liversidge Road, Higher Tranmere, Birkenhead.
Charles James Millar, c/o Messrs. Turner, Morrison & Co., Calcutta.
George Edward Pearson, c/o Messrs. Burroughs, Wellcome & Co., Snow Hill Buildings, E.C.
Frank Moreton Thomas, 290, Rotton Park Road, Edgbaston, Birmingham.
Sidney Gilbert Walton, "Kensington," Northwood Road, Northwood, Lane Cove River, N.S.W.
William Ord Wootton, B.Sc., 159, Maidstone Road, Rochester.
Frederick Palliser Worley, M.A., M.Sc., Mansfield House, Clifton Gardens, Maida Hill, W.

Of the following papers, those marked * were read:

*221. "The direct union of carbon and hydrogen. Synthesis of methane." By William Arthur Bone and Hubert Frank Coward.

The recent work of Berthelot, Pring and Hutton, and Mayer and Altmayer on this subject was critically reviewed. The results of new experiments were described which demonstrate the formation of large quantities of methane when less than 0·1 gram of sugar-charcoal (highly purified by prolonged ignition in dry chlorine, first of all at 700° and then at 1100°) is heated in a stream of pure dry hydrogen to between 1100° and 1200° in an apparatus similar to that used by Bone and Jerdan in 1897.

In two separate experiments, the yields of methane (namely, 137·0 c.c. and 125·5 c.c. at 0° and 760 mm. from 0·0995 and 0·092 gram of carbon respectively) were as much as 73 per cent. of those theoretically obtainable, the remainder of the methane being lost by unavoidable oxidation or decomposition in contact with the intensely hot walls of the porcelain tube in which the carbon was heated. In one group of four experiments, the formation of altogether 422 c.c. of methane from 0·306 gram of carbon was demonstrated. The authors therefore consider that the synthesis of methane from its elements, as originally carried out by Bone and Jerdan in 1897 and 1901, is fully confirmed.

Incidentally, the results of analyses of the sample of highly purified carbon originally used by Bone and Jerdan were given, showing that the hydrogen in it did not exceed 0·06 per cent., of which at least part would be occluded.

DISCUSSION.

Dr. **LOWRY**, as evidence of the unreliability of thermodynamic calculations of high temperature equilibria, referred to the case of nickel oxide, where the pressure of oxygen at 1127° had been calculated by Stahl (*Metallurgie*, 1907, **4**, 682) as 0·000000033 mm., the values actually observed (Foote and Smith, *J. Amer. Chem. Soc.*, 1908, **30**, 1349) being 5·5 mm. at 1100° and 13·0 mm. at 1200°. The value calculated for 227° was $1{\cdot}859 \times 10^{-45}$, or roughly $0{\cdot}5 \times 10^{-21}$ molecule per 22·4 litres, and in the case of zinc oxide, $1{\cdot}333 \times 10^{-67}$ or $0{\cdot}3 \times 10^{-43}$ molecule, figures which, in spite of the formal exactness, were of such ultra-electronic minuteness as to have no significance whatever.

Dr. **FEILMANN** asked whether Prof. Bone could supply information as to the black substance formed by the methane on the walls of the porcelain tube in which the reaction took place, and suggested that it might contain carbon, due to decomposition of the methane formed; such decomposition might be promoted both by the walls of the tube being presumably rather hotter than the body of the gas, and also by the special action which was well known to be peculiar to solid surfaces in similar circumstances. It was difficult to believe that the coloration could be due to the formation of silicon in the porcelain, and it presumably contained no lead.

Prof. Bone, in reply, wished it to be understood that he did not attack Nernst's thermodynamical arguments as being, from the abstract point of view, unsound—this not being the point raised in the paper—but merely contended that for calculating high temperature equilibria they were at present useless, owing to defective knowledge of the measure of the thermal factors involved. There was nowadays a tendency, in certain quarters, to overestimate the value of mathematical deductions in relation to chemical phenomena, and it was necessary to protest against the practice of setting aside the results of carefully conducted experiments on merely mathematical grounds.

In answer to Dr. Feilmann, he was afraid he could give no definite information as to what particular constituent of the porcelain or the glaze of the inner tube had been reduced by the methane; presumably it might be the silica, and certainly the appearance of the tube suggested this. With regard to the mechanism of the process, it might be either a direct reduction by methane itself, or a secondary effect due to carbon liberated by a primary decomposition of methane in contact with the hot surface.

*222. "The relation between absorption spectra and chemical constitution. Part XI. Some aromatic hydrocarbons." By Edward Charles Cyril Baly and William Bradshaw Tuck.

The authors have examined the absorption spectra of the following hydrocarbons: naphthalene, acenaphthene, acenaphthylene, fluorene, chrysene, anthracene, phenanthrene, diphenyl, and dibenzyl. Certain minor differences from Hartley's observations of naphthalene, anthracene, and phenanthrene (*Trans.*, 1881, **39**, 153; 1885, **47**, 685) have been noted. In some cases the absorption of the hydrocarbons shows considerable similarity among themselves, from which it has been found possible to gain some insight into the dynamic condition of these substances.

*223. "Organic derivatives of silicon. Part VII. The synthesis of *dl*-sulphobenzylethyl*iso*butylsilicyl oxide." By Bernard Dunstan Wilkinson Luff and Frederic Stanley Kipping.

The only optically active silicon compounds which have hitherto been described, namely, the *d*- and *l*-forms of sulphobenzylethylpropylsilicyl oxide,

$$SO_3H{\cdot}C_6H_4{\cdot}CH_2{\cdot}SiEtPr{\cdot}O{\cdot}SiEtPr{\cdot}CH_2{\cdot}C_6H_4{\cdot}SO_3H,$$

have very low specific rotations, and in many cases when they are combined with a given optically active base their enantiomorphous relationship is not very clearly indicated.

Although there can be no doubt that the molecules of these acids are asymmetric, it seemed desirable to prepare, if possible, some other compound of the same type. With this object, the authors have synthesised *benzylethyl*iso*butylsilicyl chloride*, $SiEt(C_7H_7)(C_4H_9)Cl$, b. p. 198—202° (100 mm.); *benzylethyl*iso*butylsilicol*, $SiEt(C_7H_7)(C_4H_9){\cdot}OH$, b. p. 162—164° (25 mm.), and *benzylethyl*iso*butylsilicyl oxide*,

$$[SiEt(C_7H_7)(C_4H_9)]_2O,$$

b. p. 250—252° (20 mm.). Each of these three substances was then sulphonated with the aid of chlorosulphonic acid, and also in the case of the silicol and the oxide with concentrated sulphuric acid. The product in all cases was a mixture from which the same *dl*-acid, namely, dl-*sulphobenzylethyl*iso*butylsilicyl oxide*, was isolated in the form of its l-*menthylamine* salt; this compound,

$$[SiEt(C_4H_9){\cdot}CH_2{\cdot}C_6H_4{\cdot}SO_3H]_2O,2C_{10}H_{21}N,4H_2O,$$

melts at 240—245°, and its specific rotation is $[\alpha]_D$ $-14{\cdot}7°$ in methyl-alcoholic solution; it is not resolved by fractional crystallisation.

From the *l*-menthylamine derivative, the *sodium* salt of the pure *dl*-acid was obtained, and from the latter the d-*bornylamine*, *cinchonidine*, and *cinchonidine hydrogen* salts were prepared.

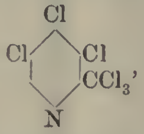
Experiments on the resolution of this *dl*-acid will be described at an early date.

*224. "The relation between viscosity and chemical constitution. Part III. The enol-ketonic tautomerism." By Albert Ernest Dunstan and James Arthur Stubbs.

The authors have investigated the viscosity of ethyl acetoacetate, ethyl ethylacetoacetate, and ethyl diethylacetoacetate, alone and in various solvents. They have also studied the effects of piperidine and sodium ethoxide on ethyl acetoacetate. In confirmation of the work of Brühl, Perkin, Drude, Schaum, Knorr, and Lowry on these and similar compounds, they conclude that ethyl acetoacetate is mainly existent in the ketonic condition.

225. "The chlorination of methyl derivatives of pyridine. Part II. 2-Methylpyridine." By William James Sell.

When α-picoline hydrochloride saturated with hydrogen chloride is chlorinated at 105—110° until no further action is apparent, an oily mixture of chlorinated derivatives is obtained, which, on the removal of the excess of chlorine and hydrogen chloride by a current of dry air, partly solidifies. The solid compound thus obtained was shown (Part I, *Trans.*, 1905, **87**, 799) to have the constitutional formula :



and the author has now examined the liquid part of the products. The chief constituent of this oily liquid is *pentachloropicoline*,

$$C_5H_2Cl_2N{\cdot}CCl_3.$$

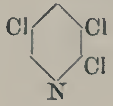
This compound readily yields 3 : 5-*dichloropicolinic acid*, which crystallises from water in needles melting at 153—154°. The *methyl* ester and the *amide* have been prepared. On heating, the acid is converted into 3 : 5-*dichloropyridine*, m. p. 66—67°.

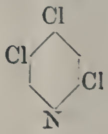
226. "The chlorine derivatives of pyridine. Part IX. Preparation and orientation of 3:5-dichloropyridine." By William James Sell.

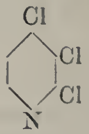
The well-marked basic characters of this substance, together with its great stability, suggested that the chlorine atoms in this compound occupy the 3 : 5 position. This conclusion is strengthened by the analogy in general properties and stability under similar conditions to the dibromopyridine, m. p. 110—111°, in which the bromine atoms are known to occupy the positions 3 : 5. The orientation was carried out by converting specimens of the 3 : 5-dibromopyridine and the dichloropyridine in question into diethoxypyridine, and showing that the diethoxypyridines from the two sources yield identical compounds with bromine and with chlorine.

227. "The chlorine derivatives of pyridine. Part X. Orientation of 2 : 3 : 5-trichloropyridine." By William James Sell.

Excluding the trichloropyridines of known constitution, and having regard to the feeble, but distinct, basic properties of the compound in question, there seemed every probability that its constitution should be represented by one of the following formulæ:


(I.)


(II.)


(III.)

of which (I) was regarded as sufficiently probable to warrant the attempt to determine its constitution on the following lines.

Such a compound ought to be attacked by ammonia, giving 3 : 5-dichloro-2-aminopyridine. This was carried out, and a substance melting at 84—85° was isolated. Further, 3 : 5-dichloropicolinamide (this vol., p. 225) was converted by the Hofmann reaction into 3 : 5-dichloro-2-aminopyridine.

The compound thus prepared melted at 84—85°, and the melting point was unaffected by admixture with the specimen obtained by the action of ammonia on the trichloropyridine in question. Moreover, Königs and Geigy have described (*Ber.*, 1884, **17**, 589, 1833) a dichloroethoxypyridine obtained from this trichloropyridine by the action of sodium ethoxide. This substance was converted into the dichlorohydroxypyridine, m. p. 178°, by heating with hydrochloric acid.

Finally, 3 : 5-dichloro-2-aminopyridine was converted by a modification of the Bouveault reaction into the same dichlorohydroxypyridine, m. p. 178—179°, as was obtained from the trichloropyridine in question.

228. "The triazo-group. Part V. Resolution of α-triazopropionic acid." By Martin Onslow Forster and Hans Eduard Fierz.

l-α-*Triazopropionic acid*, $CH_3 \cdot CHN_3 \cdot CO_2H$, has the specific gravity 1·2293 compared with water at 21°, and $[\alpha]_D$ $-2 \cdot 27°$; a 16 per cent. solution in ether has $[\alpha]_D$ $-28 \cdot 9°$, and a 21 per cent. solution in water, $[\alpha]_D$ $+4 \cdot 8°$. The *brucine* salt, $C_{26}H_{31}O_6N_5$, has not a definite melting point, but evolves gas at about 150°; the aqueous solution displays mutarotation, the permanent value being $[\alpha]_D$ $-26 \cdot 4°$ in a concentration of 4 per cent. The *ethyl* ester, $C_5H_9O_2N_3$, boils at 49° under 5 mm. pressure, has specific gravity 1·063 compared with water at 22°, and $[\alpha]_D$ $-18 \cdot 2°$; the *amide*, $C_3H_6ON_4$, melts at 85° and is dextrorotatory, having $[\alpha]_D$ 49·1° in water. When *l*-α-triazopropionic acid is reduced with aluminium amalgam, *d*-alanine is formed.

229. "The triazo-group. Part VI. Triazoethyl alcohol and triazoacetaldehyde." By Martin Onslow Forster and Hans Eduard Fierz.

Triazoethyl alcohol (2-*triazoethanol*-1), $N_3\cdot CH_2\cdot CH_2\cdot OH$, prepared from ethylene chlorohydrin and sodium azide, is a colourless, sweet-tasting, odourless liquid, having specific gravity 1·149 compared with water at 24°, and boiling at 60° under 8 mm. pressure; treatment with stannous chloride eliminates nitrogen and produces aminoethyl alcohol. *Triazoethyl acetate*, $CH_3\cdot CO_2\cdot C_2H_4N_3$, has specific gravity 1·126 compared with water at 24°, and boils at 74° under 20 mm. pressure; the odour is much more pronounced than that of ethyl triazoacetate, resembling that of ethyl acetate in character and intensity.

Triazoethyl p-*nitrobenzoate*, $NO_2\cdot C_6H_4\cdot CO_2\cdot C_2H_4N_3$, melts at 82°, and, on reduction with tin and hydrochloric acid, yields p-*aminobenzoyl-oxyethylamine*, $NH_2\cdot C_6H_4\cdot CO_2\cdot C_2H_4\cdot NH_2$, which melts at 78° when crystallised with $1H_2O$, the anhydrous base melting at 122·5°; the *picrate* and *dibenzoyl* derivative melt at 172—175° and 212° respectively.

Triazoacetaldehyde, $N_3\cdot CH_2\cdot CH\colon O$, obtained from chloroacetaldehyde hydrate and sodium azide, is an oil, which has not been purified on account of the readiness with which it undergoes change on heating or when treated with various agents; its behaviour towards alkalis resembles that of the triazo-ketones.

230. "Contribution to the chemistry of the cholesterol group. Part II. Some oxidation products of sitosterol." By Robert Howson Pickard and Joseph Yates.

The behaviour on oxidation of the vegetable cholesterol, sitosterol, has been studied. This alcohol, which is obtained from the fat contained in wheat, yields oxidation products which are analogous to those given by cholesterol itself.

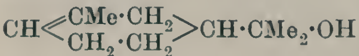
Using a nomenclature similar to that of Windaus (*Arch. Pharm.*, 1908, [ii], **246**, 117) for cholesteryl derivatives, the following are the products obtained :—by the action of hydrogen peroxide on sitosterol, *dehydrositostanetriol*, $C_{27}H_{46}O_3$, m. p. 252°, and its *diacetate*, m. p. 138—139°; by the action of chromium trioxide on the triol, *dehydrositostanedionol*, $C_{27}H_{42}O_3$, m. p. 256°; by the action of dehydrating agents on the dionol, *dehydrositostenedione*, $C_{27}H_{40}O_2$, m. p. 166°, and its *monophenylhydrazone*, m. p. 247°; by the action of zinc dust on the unsaturated dione, *dehydrositostanedione*, $C_{27}H_{42}O_2$, m. p. 196°, and its *dioxime*, m. p. 187°; by the oxidation of the saturated dione with chromium trioxide, a *ketodicarboxylic acid*, $C_{27}H_{42}O_5$, m. p. 236°, and its *dimethyl* ester, m. p. 107°, and also the *oxime* of the ester, m. p. about 90°.

231. "Experiments on the synthesis of the terpenes. Part I (cont.). Resolution of *dl*-1-methyl-Δ^1-*cyclo*hexene-4-carboxylic acid and synthesis of the optically active modifications of terpineol." By Kenneth Fisher and William Henry Perkin, jun.

The authors have synthesised *d*- and *l*-terpineol from the esters of the *d*- and *l*-modifications of 1-methyl-Δ^1-*cyclo*hexene-4-carboxylic acid, $\mathrm{CMe}{<}\genfrac{}{}{0pt}{}{\mathrm{CH{-}CH_2}}{\mathrm{CH_2\cdot CH_2}}{>}\mathrm{CH\cdot CO_2H}$, and have attempted to convert them into the optically active modifications of limonene.

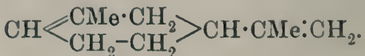
232. "Experiments on the synthesis of the terpenes. Part XIII. Synthesis of *iso*carvestrene ($\Delta^{6:8(9)}$-*m*-menthadiene) and its derivatives." By Kenneth Fisher and William Henry Perkin, jun.

The authors have synthesised 1-*methyl*-Δ^6-cyclo*hexene*-3-*carboxylic acid*, and have converted it into *dihydro*iso*carvestrenol* (I) and iso*carvestrene* (II):



$\mathrm{CH}{<}\genfrac{}{}{0pt}{}{\mathrm{CMe\cdot CH_2}}{\mathrm{CH_2\cdot CH_2}}{>}\mathrm{CH\cdot CMe_2\cdot OH}$

(I.)

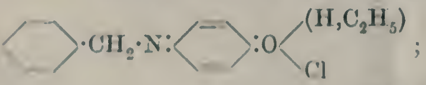


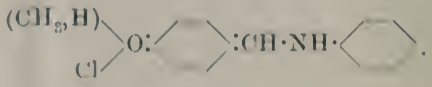
$\mathrm{CH}{<}\genfrac{}{}{0pt}{}{\mathrm{CMe\cdot CH_2}}{\mathrm{CH_2{-}CH_2}}{>}\mathrm{CH\cdot CMe{:}CH_2}.$

(II.)

233. "Colour and constitution of azomethine compounds. Part II." By Frank George Pope and Robert Fleming.

The simplest hydroxyazomethine compounds and their ethers are colourless substances, but their hydrochlorides, which are formed by passing hydrogen chloride into benzene solutions of the azomethines, show absorption in the blue and violet region of the visible spectrum. Consequently, it seems necessary to conclude that the salts formed by the action of mineral acids on the azomethines possess a different structure from the azomethines themselves, and it appears most rational to regard them as oxonium salts, thus:



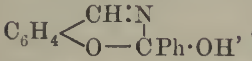


234. "Aromatic arsonic acids." By Marmaduke Barrowcliff, Frank Lee Pyman and Frederic George Percy Remfry.

Sodium *bis*-2-aminotolyl-5-arsinate described by Pyman and Reynolds (*Trans.*, 1908, **93**, 1180) is of little use in trypanosomiasis. The authors have prepared several derivatives of *p*-aminophenylarsonic acid and 2-aminotolyl-5-arsonic acid for possible use in trypanosomiasis; their trypanocidal properties were found to be very slight.

235. "The condensation of salicylaldehyde and benzamide." By Arthur Walsh Titherley and Morris Edgar Marples.

The condensation of salicylaldehyde and benzamide in the presence of sodium acetate produces two isomeric *salicylidenebenzamides*, $HO{\cdot}C_6H_4{\cdot}CH{:}N{\cdot}CO{\cdot}C_6H_5$, and not the cyclic "coumarazine,"



$C_6H_4{<}\begin{matrix}CH{:}N\\ O-CPh{\cdot}OH\end{matrix}$, described by Cebrian (*Ber.*, 1898, **31**, 1592). The two compounds, which are similar in properties and phenolic in character, were separated by means of acetone.

When condensation between salicylaldehyde and benzamide occurs in presence of hydrogen chloride, wandering of benzoyl occurs, and O-N-N-*tribenzoylsalicylidenediamine*, $BzO{\cdot}C_6H_4{\cdot}CH(NHBz)_2$, m. p. 198°, is formed, which is hydrolysed by pyridine and alkali, forming ammonia, benzoic acid, salicylaldehyde, and dibenzamide. The production of the latter shows that a wandering of benzoyl takes place similar to that which occurs in the synthetic formation of the tribenzoyl derivative.

By cautious hydrolysis of the tribenzoyl derivative with cold aqueous alcoholic sodium hydroxide, one benzoyl group is eliminated with the production of N-N-*dibenzoylsalicylidenediamine*,

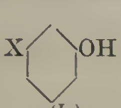
$$HO{\cdot}C_6H_4{\cdot}CH(NH\,Bz)_2,$$

m. p. 192°.

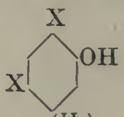
236. "The coumarin condensation." By Arthur Clayton.

A study has been made of the formation of coumarins from substituted phenols and malic acid or ethyl acetoacetate. The following conclusions are drawn:

(1) Phenols of the types shown in formulæ (I) and (II) (where X is an alkyl, hydroxyl, or dialkylamino-group) condense readily with malic acid or ethyl acetoacetate to form derivatives of coumarin:



(I.)



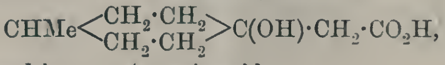
(II.)

(2) Chlorine as a substituent has an effect similar to that of the above groups, but its influence is very much less marked.

(3) The introduction of such substituents as NO_2, CO_2H, and $CO_2\cdot C_2H_5$ prevents condensation.

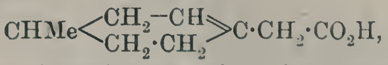
237. "Experiments on the synthesis of 1-methyl*cyclo*hexylidene-4-acetic acid." Part II. By Victor John Harding, Walter Norman Haworth, and William Henry Perkin, jun.

The authors bring forward evidence which, in their opinion, clearly proves that the acid of melting point 41°, obtained by Marckwald and Meth (*Ber.*, 1906, **39**, 1171) by the elimination of water from 4-hydroxy-1-methyl*cyclo*hexyl-4-acetic acid,



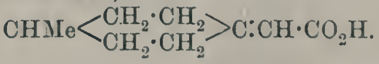
$$CHMe{<}\begin{array}{l}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{array}{>}C(OH)\cdot CH_2\cdot CO_2H,$$

is 1-methyl-Δ^3-*cyclo*hexene-4-acetic acid,



$$CHMe{<}\begin{array}{l}CH_2-CH\\ CH_2\cdot CH_2\end{array}{\geqslant}C\cdot CH_2\cdot CO_2H,$$

and not, as the above investigators claim to have established, 1-methyl*cyclo*hexylidene-4-acetic acid,



$$CHMe{<}\begin{array}{l}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{array}{>}C{:}CH\cdot CO_2H.$$

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Avogadro, *Amedeo.* Sur la densité des corps solides et liquides comparée avec la grosseur de leurs molécules, et avec leurs nombres affinitaires. Mémoire I et II. [Mem. Accad. Sci. Torino. XXX, 1824, pp. 81—154. XXXI, 1824, pp. 1—94.] (*Reference.*)
From Professor J. Emerson Reynolds.

Bayliss, *W. M.* The nature of enzyme action. [Monographs of biochemistry.] pp. x + 90. London 1908. (*Recd.* 23/10/08.)
From the Publishers: Messrs. Longmans, Green & Co.

Beadle, *Clayton.* Chapters on papermaking. Vol. V. Concerning the theory and practice of beating. pp. viii + 182. ill. London 1908. (*Recd.* 22/10/08.) From the Author.

Berthelot, *M.* Explosives and their power. Translated and condensed from the French of M. Berthelot by *C. Napier* **Hake** and *William* **Macnab.** pp. xi + 563. ill. London 1892. (*Recd.* 5/8/08.)
From William Macnab, Esq.

Blanchard, *Arthur A.* Synthetic inorganic chemistry. pp. viii + 89. New York 1908. (*Recd.* 30/8/08.)
From the Publishers: Messrs. J. Wiley & Sons.

Canada, *Department of the Interior.* Atlas of Canada. pp. 21. 83 plates. 1906. (*Reference.*) From the Department.

Clowes, *Frank.* A treatise on qualitative analysis and practical chemistry. 8th edition. pp. xxiii + 518. London 1908. (*Recd.* 5/6/08.) From the Publishers: Messrs. J. & A. Churchill.

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Curtius, *Theodor,* and **Rissom,** *Johannes.* Geschichte des Chemischen Universitäts-Laboratiums zu Heidelberg seit der Gründung durch Bunsen. Zur Feier der Enthüllung des Bunsendenkmals in Heidelberg. pp. iv + 56. ill. (*Recd.* 1/9/08.) From Geh. Rat Prof. Dr. Curtius.

Gatehouse, *Frank B.* A handbook for cement works' chemists. pp. viii + 142. ill. London 1908. (*Recd.* 27/10/08.) From the Author.

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Hinds, *J. I. D.* Inorganic chemistry. With the elements of physical and theoretical chemistry. 2nd edition. pp. viii + 651. ill. New York 1908. (*Recd.* 29/10/08.) From the Author.

Holleman, *Arnold Frederick.* A textbook of inorganic chemistry. 3rd English edition, issued in co-operation with *Hermon Charles* **Cooper**. pp. viii + 502. ill. New York 1908. From the Publishers: Messrs. John Wiley & Sons.

Jurisch, *Konrad W.* Saltpeter und sein Ersatz. pp. viii + 356. ill. Leipzig 1908. (*Recd.* 29/6/08.) From the Author.

Le Chatelier, *Henry.* Leçons sur le carbone, la combustion, le lois chimique. pp. xiv + 456. ill. Paris 1908. (*Recd.* 12/8/08.) From the Author.

Lister Institute of Preventive Medicine. Collected papers. No. 4. London 1907. (*Reference.*) From the Director.

London, University of. The Libraries of London: a guide for students. Prepared on the instruction of the Senate of the University of London by *Reginald Arthur* **Rye.** pp. 90. London 1908. (*Reference*). From the University.

Lunge, *George.* [*Editor.*] Technical methods of chemical analysis. English translation from the latest German edition, adapted to English conditions of manufacture, edited by *Charles Alexander* **Keane.** Vol I, in two parts. pp. xxiv + 996. ill. London 1908. (*Recd.* 10/10/08.) From Dr. C. A. Keane.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 7th, 1908.

All persons who received Grants in December, 1907, or in December of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Tuesday, December 1st.

The Council wish to draw special attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in Inorganic and Metallurgical Chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the Coal-tar and Allied Industries.

At the next Ordinary Meeting on **Thursday**, November **19**th, 1908, at **8.30** p.m., the following papers will be communicated :

"Meteloidine : a new solanaceous alkaloid." By F. L. Pyman and W. C. Reynolds.

"The affinity of certain alkaloids for hydrochloric acid." By V. H. Veley.

"The affinity constants of bases as determined by methyl-orange." By V. H. Veley.

"The relation between absorption spectra and chemical constitution. Part XII. Some amino-aldehydes and -ketones of the aromatic series." By E. C. C. Baly and Miss E. G. Marsden.

"Organic derivatives of silicon. Part VIII. The resolution of *dl*-sulphobenzylethyl*iso*butylsilicyl oxide, and the properties of the optically active acids." By B. D. W. Luff and F. S. Kipping.

"Study of the constitution and properties of the rhodanides of inorganic radicles. Part I." By A. E. Dixon and J. Taylor.

"The action of phosphorus pentachloride on the methylene ethers of catechol derivatives. III. The cyclic carbonates of dichloro-ethyl- and propyl-catechol." By G. Barger.

"The synthesis of thionaphthen derivatives from styrenes and thionyl chloride." By G. Barger and A. J. Ewins.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 28/11/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24 No. 347.

Thursday, November 19th, 1908, at 8.30 p.m., SIR WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

The PRESIDENT announced that the Society had become indebted to Professor J. Emerson Reynolds, F.R.S., for presenting a bust of Michael Faraday.

Certificates were read for the first time in favour of Messrs.:

Arthur Clayton, B.Sc., 35, Sisters Avenue, Clapham Common, S.W.
John Charles Jesser Coope, Bulawayo, Rhodesia, S. Africa.
Arthur Gordon Francis, B.Sc., 50, Whitbread Road, Brockley, S.E.
Ross Aiken Gortner, M.A., B.Sc., Lincoln, Nebraska, U.S.A.
Frank Higson, Ivy Bank, Castle Street, Haulgh, Bolton.
James Henry Hoseason, Alderside, Timperley, Cheshire.
Ralph Hough, 14, Longford Place, Victoria Park, Manchester.
Percy May, 126, Cazenove Road, Stamford Hill, N.
Frank George Pope, 28, Alcester Crescent, Upper Clapton, N.E.
Philip John Sageman, 160, Brecknock Road, N.

Certificates have been authorised by the Council for presentation to ballot under Bye-law I (3) in favour of Messrs.:

Thomas Boles Allen, M.A., Medical Faculty, McGill University, Montreal.
Maung Ba, B.A., Rangoon College, Rangoon.
Prince Mom Chow Bhunsri, Saranrome Palace, Bangkok, Siam.
Maung San U, Government Laboratory, Rangoon.

Herbert M. Shilstone, B.Sc., 410, South Front Street, New Orleans, U.S.A.
Rev. John Watt, M.A., Scottish Churches College, Calcutta.

Of the following papers, those marked * were read:

*238. "Meteloidine: a new solanaceous alkaloid."

By Frank Lee Pyman and William Colebrook Reynolds.

Datura meteloides yields 0·4 per cent. of total alkaloid, from which 0·13 per cent. of hyoscine, 0·03 per cent. of atropine, and 0·07 per cent. of a new alkaloid, *meteloidine*, have been obtained.

Meteloidine, $C_{13}H_{21}O_4N$, crystallises in tabular needles, melting at 141—142°. It forms crystalline salts, of which the *hydrobromide*, $C_{13}H_{21}O_4N,HBr,2H_2O$ (needles, m. p. 250°), *aurichloride*,

$$C_{13}H_{21}O_4N,HAuCl_4,\tfrac{1}{2}H_2O$$

(hexagonal plates, m. p. 149—150°), and *picrate* (hexagonal plates, m. p. 177—180°) have been prepared. It is optically inactive, and has no marked physiological action.

It is readily hydrolysed by hot aqueous barium hydroxide, with the formation of tiglic acid and a new base, *teloidine*, according to the equation: $C_{13}H_{21}O_4N + H_2O = C_5H_8O_2 + C_8H_{15}O_3N$.

Teloidine crystallises from moist acetone in needles, which contain one molecule of water of crystallisation, and, after drying at 120°, melts at 168—169°. It forms crystalline salts, of which the *hydrochloride*, $C_8H_{15}O_3N,HCl$ (prisms, m. p. above 300°), *hydrobromide*, $C_8H_{15}O_3N,HBr$ (hexagonal plates, m. p. 295°), and *aurichloride*, $C_8H_{15}O_3N,HAuCl_4,\tfrac{1}{2}H_2O$ (hexagonal plates, m. p. 225°) have been characterised.

Attention was drawn to the similarity of the properties of teloidine with those of tropine and oscine.

*239. "The affinity of certain alkaloids for hydrochloric acid."

By Victor Herbert Veley.

Determinations have been made of the affinity values of the nitrogen atoms or amino-groups of certain alkaloids, which, although containing more than one atomic proportion of nitrogen, yet form stable combinations with one molecular proportion of hydrogen chloride, the dihydrochlorides being produced only under special conditions, or not, as yet, having been obtained. It was shown by the application of the methyl-orange method that in all cases the affinity values of these amino-groups are of a widely different order.

In the case of the cinchona alkaloids, the affinity value of one amino-group is rather less than that of a hydropyridine, whilst that of the other is rather lower than that of quinoline. These results are in accordance with the accepted constitution of these alkaloids and the thermo-neutrality values obtained by addition of one and two molecular proportions of hydrogen chloride respectively.

In the case of pilocarpine, the value of one grouping is intermediate between that of ammonia and the limit value of the methyl-orange method, whilst that of the other is equal to those of true amphoteric electrolytes.

A methylglyoxaline was examined on account of the relationship of pilocarpine to these compounds; the value of the two amino-groups and its general behaviour correspond with a diamino-base of the type of hydrazine.

Of the *Nux Vomica* alkaloids, strychnine and brucine were examined; in both cases, the affinity value of one amino-group was beyond the limit value of the methyl-orange method, whilst that of the other corresponded with the betaines, which is in accordance with the views held regarding their constitution.

DISCUSSION.

Dr. VELEY, in reply to Dr. Jowett, stated that so far as results had been obtained it appeared probable that if an alkaloid was constituted of two residues, either or both containing an amino-group, the affinity value of the one was affected by that of the other.

This had been observed more especially in the case of tropine, the parent base of the atropine and cocaine alkaloids, the results for which it was hoped shortly to communicate to the Society.

*240. "The relation between absorption spectra and chemical constitution. Part XII. Some amino-aldehydes and -ketones of the aromatic series." By Edward Charles Cyril Baly and Effie Gwendoline Marsden.

The absorption spectra of *o*- and *p*-aminobenzaldehyde and the three isomeric aminoacetophenones have been observed; they all exhibit a single broad absorption band which is within the visible region of the spectrum, so that the substances are visibly coloured. The addition of a small quantity of alcoholic hydrochloric acid to the solution of each of the compounds causes a considerable deepening of the colour, which is due to the formation of a new absorption band nearer to the red than the principal band referred to above. This phenomenon does not occur in aqueous solution, and is most evident with the para-isomeride and least with the meta. It has also been observed in the case of tetramethyldiaminobenzophenone and the aminobenzaldoximes. The phenomenon is apparently due to an increased activity of the amino-group, and hence affords an explanation of the catalytic action of mineral acid on the acetylation of amino-compounds.

DISCUSSION.

Dr. HEWITT inquired if the absorption spectrum of *p*-aminobenzaldehyde in presence of a small quantity of hydrochloric acid was measured in absolute alcoholic solution, and he also wished to know how the substance was isolated in a pure condition.

Mr. BALY, in reply to Dr. Lowry, said that the original compound was restored when the acid was neutralised. In reply to Dr. Forster: the absorption spectrum of the hydrochloride was entirely different from that of the base in presence of a trace of alcoholic hydrogen chloride. Considerable difficulty had been experienced in the preparation of *p*-aminobenzaldehyde. It was obtained from *p*-aminobenzaldoxime and then regenerated from its hydrochloride. The melting point was correct, and, moreover, the condensation product was very different from the aminobenzaldehyde itself in that it was only very slightly soluble in alcohol.

*241. "Organic derivatives of silicon. Part VIII. The resolution of *dl*-sulphobenzylethyl*iso*butylsilicyl oxide and the properties of the optically active acids." By Bernard Dunstan Wilkinson Luff and Frederic Stanley Kipping.

dl-*Sulphobenzylethyl*iso*butylsilicyl oxide*,

$$[SO_3H\cdot C_6H_4\cdot CH_2\cdot SiEt(C_4H_9)]_2O,$$

is resolved into its optically active components by the fractional crystallisation of its salt with *d*-methylhydrindamine; the pure *d*A*d*B-salt obtained melts at 207—209°, and has $[\alpha]_D + 16\cdot 7°$ in methyl-alcoholic solution. The specific rotation of the sodium salt of the *d*-acid is $[\alpha]_D + 10\cdot 4°$. The pure *l*A*l*B-salt (melting at 207—209° and having $[\alpha]_D - 17\cdot 0°$ in methyl-alcoholic solution) is obtained by fractionally crystallising the salt of the *dl*-acid with *l*-methylhydrindamine; the specific rotation of the sodium salt of the pure *l*-acid is $[\alpha]_D - 10\cdot 5°$.

d-*Methylhydrindamine* l-*sulphobenzylethyl*iso*butylsilicyl oxide* and the corresponding *d*A*l*B-salt, prepared by combining the optically pure acids with *d*- and *l*-methylhydrindamine respectively, are oils at the ordinary temperature.

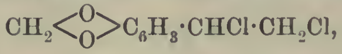
l-*Menthylamine* d-*sulphobenzylethyl*iso*butylsilicyl oxide* crystallises well (with $4H_2O$), melts when anhydrous at 254—258°, and its specific rotation in methyl-alcoholic solution is $[\alpha]_D - 13{\cdot}9°$. The salt of the *l*-acid is very similar in properties, but melts at 253—257°, and has $[\alpha]_D - 17{\cdot}2°$ in methyl-alcoholic solution. The salt of the *dl*-acid melts at 240—245°, and has $[\alpha]_D - 14{\cdot}7°$.

d-*Bornylamine* d-*sulphobenzylethyl*iso*butylsilicyl oxide* melts at 209—211°; the salt of the *l*-acid melts at 210—212°.

Cinchonidine d-*sulphobenzylethyl*iso*butylsilicyl oxide* crystallises in needles melting at 171—173°, whereas the salt of the *l*-acid melts at 181—183°; the specific rotations of the two salts, however, are practically identical, having the values $[\alpha]_D - 68{\cdot}5°$ and $[\alpha]_D - 69{\cdot}3°$ respectively in methyl-alcoholic solution. The *cinchonidine hydrogen* salts of the *d*- and *l*-acids are crystalline, and decompose at 232—234° and 229—231° respectively.

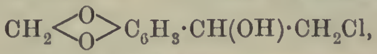
*242. "The action of phosphorus pentachloride on the methylene ethers of catechol derivatives. Part III. The cyclic carbonates of dichloro-ethyl- and -propyl-catechol." By George Barger.

From α-3 : 4-*methylenedioxyphenyl-αβ-dichloroethane*,



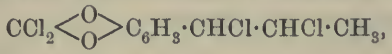
$$\mathrm{CH_2}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CHCl{\cdot}CH_2Cl},$$

b. p. 159—160°/12 mm., or from the corresponding *chlorohydrin*,



$$\mathrm{CH_2}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CH(OH){\cdot}CH_2Cl},$$

m. p. 95°, b. p. 169—170°/7 mm., the very unstable, crystalline *substance*, $\mathrm{CCl_2}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CHCl{\cdot}CH_2Cl}$, m. p. 56°, b. p. 170—174°/6 mm., was obtained; the latter is transformed by formic acid into the cyclic *carbonate*, $\mathrm{O{:}C}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CHCl{\cdot}CH_2Cl}$, b. p. 180—182°/8 mm. Similarly, from *iso*safrole dichloride, the *substances*,



$$\mathrm{CCl_2}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CHCl{\cdot}CHCl{\cdot}CH_3},$$

b. p. 174·5—175·5°/8 mm., and $\mathrm{O{:}C}\!<\!\substack{\mathrm{O}\\ \mathrm{O}}\!>\!\mathrm{C_6H_3{\cdot}CHCl{\cdot}CHCl{\cdot}CH_3}$, b. p. 186—189°/8 mm., were obtained. The cyclic carbonates are readily hydrolysed to catechol derivatives, but the latter are so unstable that they have not as yet been obtainable in the pure state.

*243. "The synthesis of thionaphthen derivatives from styrenes and thionyl chloride." By George Barger and Arthur James Ewins.

When styrene halides or allied derivatives are heated with a large excess of thionyl chloride to 180—270°, sulphur compounds result, which are most probably derivatives of thionaphthen. More or less extensive chlorination always takes place; thus $\alpha\beta$-dibromostyrene,

$$C_6H_5{\cdot}CHBr{\cdot}CH_2Br,$$

yields *hexachlorothionaphthen*, C_8Cl_6S, m. p. 158°. A number of similar derivatives from other styrenes were described.

244. "The affinity constants of bases as determined by the aid of methyl-orange." By Victor Herbert Veley.

It was shown that the methyl-orange method, as described in a previous communication (*Trans.*, 1908, **93**, 652, *et. seq.*), gives results which are concordant with those obtained by the catalysis of methyl-acetate, inversion of sucrose, and electric conductivity methods. If the last named give accurate results, then the same applies equally to the first, which possesses the advantages of simplicity of apparatus, brevity, and smaller amount of material required.

Determinations have been made of the hydrolysis and affinity constant values of about 50 cyclic bases derived from benzene, pyridine, naphthalene, and quinoline; the mutual relationship and effects produced by the substitution of one or more atomic proportions of hydrogen, whether in the nucleus or side-chain, by various elements or groupings were discussed.

The variation of the several constants, namely, $C_{(H)}$, K_W, and K_b, with temperature was dealt with, and it was shown that in cases in which determinations of these constants have been made by the same or different trustworthy methods, the experimental results obtained are in accordance with those calculated by the formula $K_{T1}/K_T = (T_1/T)^m$ (T = absolute temperature). Thus ionic dissociation, whether of water or electrolytes, cannot be differentiated in respect of temperature from any other change, generally regarded, as of a purely chemical nature. The importance of this formula for the purpose of other calculations was also emphasised.

245. "Study of the constitution and properties of the rhodanides of inorganic radicles." By Augustus Edward Dixon and John Taylor.

The mean refraction value of the ·NCS group in organic thiocarbimides being about 28·1, as calculated from the formula

$$M_D = \frac{(\mu_D - 1)p}{d\,t^\circ/4^\circ},$$

whilst that for the ·SCN group in various organic thiocyanates is about 23·3, the authors, by measuring the molecular refraction of the rhodanides, $P(CNS)_3$ and $PO(CNS)_3$, have endeavoured to ascertain the refraction effect of the rhodanic groups in these substances, with the object of deciding whether the groups have the configuration ·NCS or ·SCN.

The number found for the rhodanic group (assuming the three to be of equal value) being in each case near to 28, the authors conclude that, so far as the results of this purely physical method may be relied on as affording trustworthy evidence with respect to the atomic linking, the two rhodanides mentioned have the thiocarbimidic constitutions $P(\cdot NCS)_3$ and $PO(\cdot NCS)_3$ respectively.

Phosphoryl trithiocarbimide yields definite additive compounds with one and with two molecular proportions of aniline, or with one of diphenylamine, the products being nearly insoluble in cold water. By prolonged contact with cold water, by treatment with hot water, or by dissolution in aqueous alcohol, they are hydrolysed, yielding one-third of the contained sulphur as substituted thiocarbamide, and two-thirds as free or combined thiocyanic acid. Phosphorus trithiocarbimide (1 mol.), like the phosphoryl analogue, is precipitated completely from benzene solution by one molecular proportion of aniline; the solid product, when dissolved in cold alcohol, gives the reactions of a thiocarbamide, and is hydrolysed readily into one molecule of phenylthiocarbamide and two molecules of thiocyanic acid. The authors suggest that very pronounced electropositive or electronegative character in the inorganic radicle may have power to influence the configuration of the rhodanic group with which it is associated.

246. "The electrical conductivity of phosphoric acid."
By Harry Edward William Phillips.

Pure phosphoric acid was prepared by treating redistilled phosphorus trichloride with specially purified water at an equable temperature, and oxidising the resulting phosphorous acid by means of pure nitric acid. The hydrochloric acid and the excess of nitric acid were then expelled by heat.

The phosphoric acid thus prepared was a transparent, colourless oily liquid, which showed no tendency to crystallise in the higher strengths, but a specimen of 43 per cent. solution yielded numerous small, soft, gelatinous crystals spontaneously on cooling. The pure acid neither reddened litmus nor decomposed carbonates.

For the measurement of conductivity, Kohlrausch's telephone method was employed, and a special Wheatstone bridge was made by the author for the purpose, which gave opportunity of very accurate work.

Curves were drawn showing the actual conductivity per cent. of the acid at 0°, also a set of curves showing the comparative conductivity per cent. of sulphuric, nitric, hydrochloric, and phosphoric acids and sodium and potassium hydroxides. The results obtained were also worked out to molecular conductivities, and these were compared with the nine values previously obtained by Kohlrausch at 18°, and the more extended work of Jones and Bassett at 0°; they were also compared with the corresponding values for the three common mineral acids. Finally, curves of dissociation values, obtained by means of the formula $\frac{\Lambda}{\Lambda_{\infty}}$, were drawn.

The results seem to bear out the theory of indicators regarding the ionisation of the hydrogen atom in the molecule of phosphoric acid.

247. "The molecular volumes of the nitrites of barium, strontium, and calcium." By Prafulla Chandra Rây.

The molecular volumes of the nitrites of barium, strontium, and calcium in their monohydrated forms are 77·87, 74·59, and 67·24, whilst those of the anhydrous salts are 70·90, 62·54, and 57·56 respectively. The radicle NO_2 of the anhydrous nitrites of these metals occupies a constant volume, namely, 24·2.

248 "The formation of some carbides." By John Norman Pring.

An investigation has been made of the direct union of carbon with the elements aluminium, silicon, and iron in the absence of solid and gaseous impurities. Some preliminary experiments were also carried out with magnesium.

An intimate mixture of the metal with highly-purified carbon, both in a very fine state of division, was heated in a suitable apparatus, enabling definite constant temperatures to be maintained over long intervals, and capable of being evacuated to a pressure below 0·01 mm.

The direct union of pure silicon and carbon in a vacuum commences between 1250° and 1300°, and the presence of iron does not apparently facilitate the reaction, nor does carbon monoxide exert any influence between the limits of atmospheric pressure and 0·03 mm.

Aluminium unites directly with pure carbon in a vacuum at its melting point (650°), forming aluminium carbide, Al_4C_3, and the velocity of the reaction increases with the temperature, proceeding rapidly above 1400°.

Iron unites directly with carbon at about 700° under a pressure of about 0·05 mm.

Magnesium shows evidence of forming a new carbide below 600°, this compound giving some saturated hydrocarbon on decomposition with water or acids.

249. "4-Chloroacenaphthene."

By Holland Crompton and Eva Richardis Cyriax.

When acenaphthene in chloroform solution is treated with chlorine (1 mol.) and the solvent evaporated, an oil remains which does not crystallise on standing and from which no crystalline product could be obtained by means of solvents. On distillation, it yields some unchanged acenaphthene, and then, as main product, a distillate passing over at 305—310° which solidifies in the receiver. This consists of almost pure 4-chloroacenaphthene.

4-*Chloroacenaphthene* crystallises from alcohol in colourless leaflets; it melts at 65°, and boils at 309°; its *picrate* crystallises in yellow needles, melting at 133°. On oxidation by sodium dichromate in acetic acid solution, it yields a chloronaphthalic acid, the anhydride of which melts at 198° and the imide at 278°. When the calcium salt of this acid is heated with soda-lime, naphthalene is obtained, mixed with a little α-chloronaphthalene. If the copper salt is used in place of the calcium salt, α-chloronaphthalene is produced with little naphthalene. On fusing with potassium hydroxide at 250—260°, the acid is converted into 4-hydroxynaphthalic acid, the anhydride of which melts at 257°; this acid had previously been obtained by Graebe from 4-bromonaphthalic acid (*Annalen*, 1903, **327**, 77). The formation of this 4-hydroxynaphthalic acid and of α-chloronaphthalene show that the acid is 4-chloronaphthalic acid, and confirm the constitution given to the chloroacenaphthene.

250. "Some molecular compounds of styphnic and picric acids."

By Charles Stanley Gibson.

The following compounds have been prepared:

Acenaphthene styphnate, $C_{12}H_{10},C_6H(OH)_2(NO_2)_3$, crystallising in long, orange-coloured prisms melting at 153—154°; *phenanthrene styphnate*, $C_{14}H_{10},C_6H(OH)_2(NO_2)_3$, crystallising in yellowish-red needles melting at 125—126°; *bromonaphthalene styphnate*,

$$C_{10}H_7Br,C_6H(OH)_2(NO_2)_3,$$

crystallising in small, bright yellow needles melting at 107—108°; m-*nitroaniline styphnate*, $NH_2{\cdot}C_6H_4(NO_2),C_6H(OH)_2(NO_2)_3$, crystallising in pale yellow needles melting at 137°; and m-*nitroaniline picrate*, $NH_2 \cdot C_6H_4(NO_2),C_6H_2(OH)(NO_2)_3$, crystallising in yellow, radiating needles melting at 143°.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Manchester, City of, *Rivers Department.* Annual Report for the year ending March 25th, 1908. Manchester 1908. (*Recd.* 21/10/08.)
From the Rivers Committee.

Metropolitan Water Board. First report on research work by *A. C.* **Houston,** on the vitality of the typhoid bacillus in artificially infected samples of raw Thames, Lee, and New River water, with special reference to the question of storage. pp. 32. [London 1908.]

——— Reports of Committees. [pp. i—xxxv. Report on the results of the chemical and bacteriological examination of the London waters for the twelve months ending 31st March, 1908, by *A. C.* **Houston.**] pp. 31 + xxxv. [London 1908.] (*Recd.* 23/7/08.)
From the Metropolitan Water Board.

Meyer, *H.*, and **Tingle,** *J. Bishop.* Determination of radicles in carbon compounds. 3rd edition. pp. xiv + 218. New York 1908. (*Recd.* 11/7/8.) From the Publishers: Messrs. John Wiley & Sons.

Parry, *L.* The analysis of ashes and alloys. pp. iv + 143. London 1908. (*Recd.* 30/8/08.)
From the Publishers: "The Mining Journal."

Società Italiana per il Progresso delle Scienze. Atti. Prima riunione, Parma, Settembre 1907. pp. xxiii + 325. Roma 1908. (*Reference.*) From the Society.

Society of Chemical Industry. Decennial index of the Journal of the Society of Chemical Industry. Vols. XV to XXIV, 1896—1905. Part II, Index of Subjects. Compiled by *F. W.* **Renaut.** pp. 552. London 1908. (*Reference.*) From the Society.

Sykes, *Walter J.* The principles and practice of brewing. 3rd edition, thoroughly revised by the Author and *Arthur R.* **Ling.** pp. xviii + 588. ill. (*Recd.* 31/7/08.) From Arthur R. Ling, Esq.

Tschirch, *A.* Chemie und Biologie der pflanzlichen Sekrete. pp. 95. Leipzig 1908. (*Recd.* 30/8/08.) From the Author.

Zeitschrift für physiologische Chemie. Edited by *F.* **Hoppe-Seyler.** Vols. VI, VII, and parts 1 to 5 of Vol. VIII. Strassburg 1882—84. (*Circulating.*) From J. Parry Laws, Esq.

II. *By Purchase.*

Angeli, *Angelo.* Ueber einige sauerstoffhaltige Verbindungen des Stickstoffs. Uebersetzt von *Kurt* **Arndt.** (Sammlung, XIII). Stuttgart 1908.

Brand, *Kurt.* Die elektrochemische Reduktion organischer Nitrokörper und verwandter Verbindungen. (Sammlung, XIII). Stuttgart 1908.

Fischer, *A.* Elektroanalytische Schnellmethoden. Elektroanalyse unter Bewegen von Elektrolyt oder Elektrode. (Die chemische Analyse, Vols. 4 and 5.) pp. 304. (*Recd.* 20/6/08.)

[**Grasshoff,** *Johann.*] Philosophia Salomonis oder: Geheimes Cabinet der Natur und Kunst des Weisen Königes Salomons eröffnet durch den sogenannten grossen und kleinen Bauer wahren Besitzern des königlichen Steins. pp. [xvi] + 207. Augsburg 1753. (*Reference.*)

Groth, *Paul.* Chemische Krystallographie. Teil II. Die anorganischen Oxo- und Sulfosalze. pp. viii + 914. ill. Leipzig (*Recd.* 29/10/08.)

Handbuch der anorganisch Chemie. Edited by *R.* **Abegg** and *Fr.* **Auerbach.** Vol. II. Part 1. pp. xiii + 867. Leipzig 1908. (*Reference.*)

Hollandus, *Isaac.* Curieuse und rare chymische Operationes, worinnen nicht allein einige bisshero unbekannte Geheimnisse die rechte Universal-Tinctur zu erlangen, angezeigt; besondern das Fundament aller solcher Operationen, so in Ausziehung des Saltz und Oels aus denen Mineris bestehet, auf eine gar deutliche Weise gezeiget wird . . . Aus einem alten Autographo MSCto des Autoris heraus gegeben von R. H. C. pp. [xvi] + 400. Leipzig 1714.

Mackenzie, *Colin.* One thousand experiments in chemistry; with illustrations of natural phenomena; and practical observations of the manufacturing and chemical processes at present pursued in the successful cultivation of the useful arts. A new edition. pp. vi + 30 + v to xxxii + 646. ill. London 1822.

Schmidt, *Julius.* Die organischen Magnesiumverbindungen und ihre Anwendung zu Synthesen. II. (Sammlung, XIII). Stuttgart 1908.

Skrabal, *A.* Die induzierten Reaktionen, ihre Geschichte und Theorie. Die Reaktion Ferrosalz-Permanganat in salzsaurer Lösung. (Sammlung, XIII). Stuttgart 1908.

Waite, *Arthur Edward.* Lives of alchemystical philosophers, based on materials collected in 1815, and supplemented by recent researches. With a philosophical demonstration of the true principles of the magnum opus, or great work of alchemical re-construction, and some account of the spiritual chemistry. To which is added a bibliography of alchemy and hermetic philosophy. pp. 315. London 1888. (*Recd.* 12/11/08.)

[**Walchin,** *Dorothea Juliana.*] Das Mineralische Gluten, Doppelter Schlangen-Stab, Mercurius Philosophorum, langer und kurtzer Weg zur Universal-Tinctur. Deutlich und klärlich entdecket und angewiesen durch D. I. W. von Weimar aus Thüringen. pp. 118. Leipzig 1705. (*Reference.*)

—— Der Philosophische Perl-Baum, das Gewächse der drey Principien, zu deutlicher Erklärung des Steins der Weisen, wie er mit seinen Wurtzeln in der äusern und finstern Welt, mit seiner Blüthe aber in der Paradisischen- und Licht-Welt, und mit seiner reiffen Frucht in der Englischen und Himmlischen Welt stehet und wächset. Bescrieben durch D. I. W. von Weimar aus Thüringen. pp. 189. Leipzig 1705. (*Reference.*)

—— Schlüssel zu dem Cabinet der geheimen Schatz-Kammer der Natur, zur Such- und Findung des Steins der Weisen, durch Fragen und Antwort gestellet. Verfertiget und der Welt gezeiget durch D. I. W. von Weimar aus Thüringen. pp. 288. Leipzig 1706. (*Reference.*)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on, or before, Monday, December 7th, 1908.

All persons who received Grants in December, 1907, or in December of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Hon. Secretaries not later than Tuesday, December 1st.

The Council wish to draw special attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is to be more or less especially devoted to the encouragement of research in Inorganic and Metallurgical Chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the Coal-tar and Allied Industries.

At the next Ordinary Meeting on **Thursday**, December 3rd, 1908, at **8.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Double salts of potassium iodide with mercury iodide and camphor dimercuriodide in organic solvents." By J. E. Marsh and R. de J. Fleming-Struthers.

"Action of mercuric iodide on ketones in alkaline solution." By J. E. Marsh and R. de J. Fleming-Struthers.

"Condensation of camphor with mercuric iodide." By J. E. Marsh and R. de J. Fleming-Struthers.

"The relation between absorption spectra and chemical constitution. Part XIII. Some Pyrones and allied compounds." By E. C. C. Baly, J. N. Collie, and H. E. Watson.

"Organic derivatives of arsenic. Part I. Dicamphorylarsinic acid." By G. T. Morgan and Miss F. M. G. Micklethwait.

"Tellurium dicyanide." By H. E. Cocksedge.

"Boron thiocyanate." By H. E. Cocksedge.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those whose sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December, 3rd, 1908.

Akers, Noel Charles,

26, King's Avenue, Muswell Hill, London, N.

At present Senior Student, Junior Demonstrator, of Chemistry at City and Guilds Technical College, Finsbury. Trained at City and Guilds Technical College, Finsbury. Obtained Certificate of above. Now Senior Student, Junior Demonstrator at above. Intermediate Associate of Institute of Chemistry exam.

R. Meldola.
John Castell-Evans.
Leslie H. Berry.
Edward W. Bealey.
J. Mello Wadmore.
Chas. R. Darling.

Aubertin, Thomas,

George Anderson & Co. (1905), Ltd., Carnoustie, N. B.

Chemist to the above and to Grice's Gas Engine Co., Ltd., the two firms working in conjunction. B.A. Oxford. Honours in Chemistry, Final Examination, 1907, and wish to keep in touch with the progress of chemistry.

Andrea Angel.
Allan F. Walden.
J. E. Marsh.
H. B. Baker.
W. T. Grice.
Douglas Berridge.
D. L. Chapman.

Baker, Thomas James,

Trebarwith, Chester Road, Erdington, near Birmingham.

Senior Science Master in King Edward's High School, Birmingham. D.Sc. (London) in Chemistry; late Granville Scholar of London University. B.Sc. (Birmingham) late Tangye Scholar in Chemistry, Mason Coll., Birmingham. Science Master since 1888 in King Edward's School, Birmingham, teaching Chemistry and Physics. Lecturer on Chemistry in the Bilston Technical School since 1897.

Author of "The Thermo-chemistry of the Alloys of Copper and Zinc." Philosopical Transactions of the Royal Society, 1901, Vol. 196. Joint Author of "Note on the Electro-Deposition of Brass," *Chemical News*, July 28, 1899.

William A. Tilden. T. Slater Price.
Percy F. Frankland. Alex. Findlay.
Lionel M. Jones.

Barrett, Maurice,
Holly Bush, Headingley, Leeds.

Technical Chemist. Five years' research work in ceramics. Method for determining the fusibility of glaze silicates. Production of opalescent glazes at high temperatures. Further development of avenlinine glazes. Development of multi-coloured *salt* glazes. Investigation on the production of true malt glazes. Assoc. American Ceramic Society, Memb. English Ceramic Society, Memb. American Chemical Society, &c.

F. W. Branson. J. W. Mellor.
Thomas Fairley. *J. H. Gough.*
B. A. Burrell.

Bickerstaffe, Robert,
Chilterns, Wooburn Green, Bucks.

Works Chemist at Messrs. Thomas and Green, Ltd., Paper Makers, Wooburn Green, Bucks. I have had a 3 years' course in Faculty of Technology, Victoria University, Manchester, in Applied Chemistry. I obtained the Certificate of the University and the Diploma of School of Technology and Associateship. I am now chemist in the above Paper Works. The course included Organic and Inorganic Chemistry, the Chemical Technology of Papermaking, also Physics and German.

W. J. Pope. L. G. Radcliffe.
Jul. Hübner. F. S. Sinnatt.
Jas. Grant. C. Stanley Gibson.

Birch, William Colet, B.A., A.I.C.,
22, Glazbury Road, West Kensington, London.

Student, King's College, Cambridge. Scholar of King's College, Cambridge. Assistant Demonstrator in the University Chemical Laboratory, Cambridge.

W. J. Sell. F. W. Dootson.
H. O. Jones. H. J. H. Fenton.
Charles T. Heycock.

Brakes, William Sudderick,

137, Steade Road, Sheffield.

Schoolmaster. Educated at University College, Nottingham. At present, first assistant at Norton Lees Higher Elementary School, Sheffield. Am desirous of keeping in touch with the latest Chemical Research.

Herbert Simpson Newbould. A. H. Salway.
Harry J. Unwin. *E. R. Watson.*
F. W. Caton.

Clement, Leonard,

Beamsley, Fairhaven, nr. Lytham, Lancs.

Analyst to the Nelson Sewage Works. Exhibitioner in Natural Science, Sidney Sussex Coll., Cambridge, 1903. Scholar in Natural Science, Sidney Sussex Coll., Cambridge, 1904. Part I. Natural Science Tripos, Cambridge (Second Class), 1905. Part II. Natural Science Tripos, Cambridge (Second Class), 1906. Associate of the Institute of Chemistry, 1908. (Final Examinations in Foods, Drugs and Water.) For 15 months Temporary Assistant Analyst at the Custom House, London.

F. H. Neville. H. O. Jones.
H. J. H. Fenton. Francis Jones.
James Connah.

Cowley, Robert Charles.

College of Pharmacy and Chemistry, Brisbane, Australia.

Director (elect) of above. Formerly Principal of Liverpool School of Pharmacy. Author of "Comments on Alkaloidal Estimations of the British Pharmacopœia." Contributor and joint contributor of numerous papers on general and Pharmaceutical Chemistry.

J. W. Clayton. J. Rymer Young.
W. Hall Jowett. Peter MacEwan.
Edward Davies. *Alfred Smetham.*
William C. R. Kynaston.

Duckworth, Hugh Cecil,

66, Victoria St., Westminster, S.W.

With the 12-Hours Stove Syndicate Ltd., 66, Victoria St., London, S.W. Late Chemist to Messrs. Loders and Nucoline Ltd., Silvertown. Late Student in the Chemical Section of the Central Technical College, South Kensington. (Am desirous of attending Lectures and Papers.)

Henry E. Armstrong. T. Martin Lowry.
William Robertson. Ronald Tonkin.
Edward Horton.

Dunnicliff, Horace Barratt,

39, Herne Hill, London, S.E.

B.A. (Cantab.), B.Sc. (London). Student. First Class Natural Sciences Tripos, Part I., Cambridge, 1906. Second Class Natural Sciences Tripos, Part II. (Chemistry), 1908. B.Sc. (Honours in Chemistry) London University, 1907. Demonstrator (Assistant) of Chemistry in Cambridge University Laboratories, April, 1907, and January, 1908.

H. J. H. Fenton. F. W. Dootson.
W. J. Sell. H. O. Jones.
G. D. Liveing.

Easton, Reginald Freeman,

38, Edith Road, W. Kensington, W.

Educated at St. Paul's School. Studied Chemistry under Professor Meldola, F.R.S., at the City and Guilds Technical College, Finsbury.

R. Meldola. Arthur J. Starey.
John Castell-Evans. B. S. Evans.
F. Henry Streatfeild. *Lawrence Briant.*
Frank Clowes.

Everitt, Charles,

67, Boston Avenue, Southend-on-Sea, Essex.

Staff of the *Encyclopædia Britannica*, 11th ed. Studied chemistry at the East London College under Dr. J. T. Hewitt, M.A., D.Sc., Ph.D., from 1894—1899. Natural Science Demy of Magdalen College, Oxford, 1899—1903; First Class in Honours Mathematical Moderations, 1901; First Class in the Honours Chemistry Finals, 1902; Master of Arts of Oxford.

W. W. Fisher. A. F. Walden.
John Watts. T. S. Moore.
J. E. Marsh. J. T. Hewitt.

Girvan, Arthur Frank,

8, Chatsworth Road, West Norwood, S.E.

Chemist. B.Sc. (Lond.) Hons. Assistant Chemist Royal Commission on Sewage Disposal from Sep. '05 to the present time.

George McGowan. J. N. Collie.
William Ramsay. N. T. M. Wilsmore.
Samuel Smiles.

Green, Henry Hamilton,

36, Princes Square, Regent Park, Glasgow.

Chemistry Assistant—Lecturing, and Analytical Work. Chemistry

Assistant in the West of Scotland Agricultural College for four years. At present Assistant to Prof. Berry, Professor of Chemistry. Advanced student in the laboratories of Glasgow University; Final B.Sc. in process of completion.

R. A. Berry.
T. S. Patterson.
Charles E. Fawsitt.
Frederick Soddy.
John Ferguson.

Griffin, John,

7, Carlton Terrace, Batley, Yorkshire.

Chemistry Master. Part I and Part II (Chemistry) Science Tripos, Cambridge. Wish to keep up knowledge of Chemistry by means of the publications of the Chemical Society.

F. W. Dootson.
W. J. Sell.
H. J. H. Fenton.
H. O. Jones.
R. H. Adie.
J. Parkin.

Fairburn, Henry,

Northallerton.

Chemist. Analysis of water, milk, &c., forms a branch of my calling. Member of the Pharmaceutical Society. Student at the Pharmaceutical Society's School; attended 110 lectures on Chemistry under Professor Wyndham R. Dunstan, F.R.S., and 3 hours daily from Octr. to July for Practical Chemistry under Professor Attfield, F.R.S.

John Attfield.
John C. Umney.
Chas. Umney.
Wyndham R. Dunstan.
Thomas Tyrer.
C. T. Bennett.

Hebron, John Henry Albert,

9, Buller Street, Derby.

Chemistry Master, Municipal Secondary School, Derby. B.Sc. (Honours in Chemistry, London), 1906; Diploma in Chemistry of Derby Technical College; 7 years Chemistry Master, School of Science, Jarrow-on-Tyne (1895–1902); 6 years Chemistry Master, Municipal Secondary School, Derby (1902–1908).

A. Jamieson Walker.
P. Phillips Bedson.
F. C. Garrett.
J. A. Smythe.
J. W. Patterson.
J. Archyll Jones.

Hinks, Edward,

23, Tavistock Road, Croydon.

Analytical Chemist. B.Sc. Lond., F.I.C. Author of contributions to *The Analyst*, 1907, on the detection of cocoanut oil in butter. Public

Analyst (Temporary) for the County of Surrey and the Borough of Reigate.

R. Bodmer.
John Wade.
W. C. Ball.
Horace Finnemore.
J. H. Ryffel.

Hughes, Joseph Albert,

School of Mines, Charter Towers, Queensland.

Demonstrator in Chemistry and Assaying School of Mines, Charter Towers, Queensland. Student Charter Towers School of Mines, 1901—1905. Senior Demonstrater Chemistry and Assaying at same school from 1906 and still occupy same position. Practical mining and milling experience fifteen years. Hold diploma of Chemist and Assayer of same school.

George J. Saunders.
J. A. Schofield.
Basil Turner.
C. Walker.
F. B. Guthrie.

Hull, Thomas Ernest,

6, Selborne Terrace, Greenbank, Darlington.

Analytical Chemist. Assistant analytical and metallurgical chemist to the Darlington Forge Co., Ltd. Engaged in microscopical examination of iron and steel. Student at the Darlington Technical College from 1899—1907, having gained a "King's Prize" and success in the Honours Stage, Practical Inorganic Chemistry; also successes in Theoretical Organic and Inorganic Chemistry, Alkali Manufacture, Physiography, Practical Mathematics, Magnetism and Electricity, &c. Obtained Central Evening Scholarship for further study of Organic and Inorganic Chemistry at Armstrong College, Newcastle-on-Tyne (Session 1906—1907). Appointed Teacher in Metallurgy at the Darlington Technical College, Sept., 1907.

P. Phillips Bedson.
F. C. Garrett.
J. A. Smythe.
G. P. Dodds.
George Dean.
F. Henry Streatfeild.
S. Hoare Collins.

Irvine, James Colquhoun,

Dunmurry Rathelpie St. Andrews.

Lecturer in Organic Chemistry in the United College, University of St. Andrews, Ph.D. (Leipzig), D.Sc. (St. Andrews). Author of twenty-four papers in organic chemistry and biological chemistry. In charge of the Chemical Research Laboratory, St. Andrews.

Thomas Purdie.
James Walker.
G. Druce Lander.
Alex. Mackenzie.
H. R. LeSueur.
M. O. Forster.

Johnson, Grove,

124, Savoy Court, Strand, W.C..

Brewers' analyst and bacteriologist. "Honours" City and Guilds of London Institute. Discoverer of Saccharomyces Thermantitonum. Author of Paper on above Subject delivered before the "Institute of Brewing," July, 1905. At present writing a work on "Practical Yeast Culture for the use of Students."

Arthur C. Claudet. George T. Holloway.
Harold W. Harman. Alfred Gordon Salamon.
Arthur R. Ling.

Keiller, Patrick Anderson,

Hawkhill House, Dundee.

Analytical Chemist. Chemistry (Higher Standard) B.Sc., St. Andrews University. Three years chief assistant to Mr. Jas. Hendrick, County Analyst, Aberdeen. Twenty months Head Chemist to Messrs. J. & J. Cunningham Ltd., Manure and Cake Manufacturers, Leith. Appointed Agricultural Analyst to Colombo Commercial Co., Ltd., Ceylon.

James Walker. John Foggie.
John S. Lumsden. James Hendrick.
F. R. Japp.

Kenyon, Joseph,

6, Cheltenham Street, Blackburn.

Demonstrator in the Chemical Department of the Blackburn Technical School. B.Sc. (Lond.) 2nd class honours in chemistry. Associate of the Institute of Chemistry. Joint Author of the following papers which have appeared in the Journal of the Society. 'Contributions to the Chemistry of Oxygen Compounds." Part I. *Trans.*, 1906, 262. Part II. *Trans.*, 1907, 896. "The Resolution of Sec. Octyl Alcohol," *Trans.*, 1907, 2058.

Robert H. Pickard. W. H. Duckworth.
Joseph Yates. W. E. Bickerdike.
T. Martin Lowry.

Linch, Frank William,

9, Gladstone Avenue, Manor Park, London, E.

Lecturer and Demonstrator on Chemistry. Three years Student at City and Guilds Tech. Coll., Finsbury. Last three years Lecturer and Demonstrator at Northern Polytechnic Institute, London, N. Associate of the Institute of Chemistry. Int. B.Sc.

R. Meldola. W. H. Mills.
John Castell-Evans. John Spiller.
W. H. Glover.

Lindley, Arthur Stanley,

Prince Building, Medows Street, Bombay.

Analytical Chemist. Five years Assistant Analyst to Mr. Edward Riley, F.I.C., F.C.S., &c. Twenty-one months Chemist at Lord St. Oswald's Ironstone Mines, Frodingham, Lincolnshire. Fifteen months Chemist to The Goa Mining Co., Portuguese India. At present in charge of Messrs. Edward Riley & Co.'s Laboratory and Assay Offices, Bombay, India.

Edward Riley. A. W. Comber.
Herbert H. Dains. *Claude S. Fawcitt.*
C. D. Morewood.

MacGregor, Gregor,

Giffen Park, Dysart, Fife.

Headmaster, Viewforth Higher Grade School, Dysart. Teacher of Chemistry in same, also Headmaster Science and Art School, Viewforth, Dysart. M.A. (Glasgow). Chemistry, with Chemistry Laboratory experience. B.Sc. (Glasgow). Applied Science (Agricultural Chemistry, &c.). Six months Chem. Laboratory, West of Scotland. Agricultural College, First Prizeman (Chemical Analyses of Manures, Foods, &c.). Two years under A. Wilson, F.I.C., Stirling. Science Master and Analytical Chemist. Senior Chemistry Master, Wigan Grammar School, January, 1904, to July, 1908. Taught Chemistry, with Quantitative Chemical Analysis.

Ernest Brooks Naylor. G. Crewe Chambres.
Thomas Henry Byrom. Alfred H. Scholefield.
W. H. Leek.

Menzies, Frederick Martin Kay,

79, Davies Street, Berkeley Square, W.

Assistant Medical Officer of Health, and Demonstrator Public Health Laboratory, University College, London. M.D., F.R.C.P. (Edin.), D.P.H. (conjoint London).

H. R. Kenwood. N. T. M. Wilsmore.
Edward C. Cyril Baly. William Ramsay.
J. N. Collie.

Miles, William Herbert,

3, Liversidge Road, Higher Tranmere, Birkenhead.

Analytical Chemist. Student for three years under Dr. George Tate, F.I.C. Analytical Chemist, Liverpool. Assistant in the employ of Messrs. Evans Sons, Lescher and Webb, Limited, Liverpool, three and a half years. Analyst to the Mersey Oil and Cake Mills Co., Limited, Liverpool, two years (present occupation).

George Tate. F. Robertson Dodd.
Alfred Smetham. John Hanley.
Thomas J. Roberts.

Millar, Charles James,

c/o Messrs. Turner, Morrison, and Co., Calcutta, and 23, James Street, Greenhead, Glasgow.

Analytical Chemist. Attended classes and have certs. for full course of study in Glasgow and West of Scotland Technical College; certs., including 1st prize (1st class), Organic Chemistry. Also certs. in Technical Chemistry, including oils and fats, coal analysis, and dyeing and bleaching. Personal recommendation from Prof. Henderson of above College. Five years with Messrs. T. Henshelwood and Co., Glasgow Oil, Paint, and Colour Works. Two years with Messrs. British Dyewood and Chemical Co. as Chemist, and at present chemist in Calcutta with Messrs. Turner, Morrison and Co.

Wm. B. Jackson. G. G. Henderson.
Thomas Gray. William S. Denham.
A. B. Steven.

Minett, Edward Pigott,

Guy's Hospital, S.E.

Doctor of Medicine, and Member Royal College of Surgeons, Licentiate Royal College of Physicians. Pharmaceutical Chemist (highest record marks). Student and Assistant Chemical Laboratory of Dr. Muter. Assistant Messrs. John Bell and Co., Oxford Street, W. Assistant Bacteriological and Public Health Laboratory, Guy's Hospital, S.E.

Thos. Stevenson. J. H. Ryffel.
John Wade. Walter C. Ball.
H. Finnemore.

Morgan, Howard Houlston, B.Sc., A.R.C.S.,

Technical College, Auckland, New Zealand.

Science and Mathematical Master. Experience of Chemistry as Student and Teacher. Bachelor of Science (Lond.), Honours in Chemistry. Associate of the Royal College of Science (Three Years Internal Student National Scholar in Chemistry).

H. E. Hadley. G. T. Morgan.
William A. Tilden. G. S. Newth.
M. O. Forster. James C. Philip.

Norman, Cyril Lawrence,

36, Halesworth Road, Lewisham, S.E.

Student of Chemistry. Certificated Student of City and Guilds Technical College, Finsbury. Matriculated Student of London University.

R. Meldola.
John Castell-Evans.
Edward W. Bealey.
F. Stanley Benton.
Chas. R. Darling.
Leslie H. Berry.

Normand, Alexander Robert,

8, Hillside Street, Edinburgh.

Lecturer on Chemistry, Wilson College, Bombay. M.A., B.Sc. (Edinburgh). Lecturer on Chemistry, Wilson College, from 1902.

Alex. Crum Brown.
Leonard Dobbin.
J. P. Longstaff.
John E. Mackenzie.
Hugh Marshall.

Pearson, George Edward,

Snow Hill Buildings, London, E.C.

General Manager, Burroughs Wellcome & Co., Manufacturing Chemists, London, E.C.

Henry E. Armstrong.
Edward C. Cyril Baly.
W. B. Tuck.
Frederick B. Power.
H. A. D. Jowett.
J. N. Collie.

Pearson, John William,

Buxton College, Derbyshire.

Science Master. Second Class Honours, Cambridge Natural Science Tripos, 1904. Six months' work in a London Analytical Laboratory. Four years Chemistry teaching. A desire to keep abreast of the times in Chemical Science.

Edward D. Walrond.
F. H. Neville.
Charles T. Heycock.
Robert Wright.
E. H. Farr.

Perry, Frank,

63, Tunnel Street, Coseley, near Bilston, Staffs.

Analytical and Research Chemist. Four (4) years at Finsbury Technical College. General Commercial Analysis one year. Assistant Chemist to Messrs. Howards & Sons, Ltd., of Stratford, for two years. Research Chemist to Sherard, Cowper-Coles & Co., and "Metalloids," Ltd., Tipton, for two years. Published joint paper with Bernard Howard, Esq., before the Society of Chemical Industry, 5th December, 1905.

R. Meldola.	Edward W. Bealey.
John Castell-Evans.	W. Hansen Rawles.
Leslie H. Berry.	F. Henry Streatfeild.

Power, George O'Brien,

Fatehpur, U. P. of Agra and Oudh, India.

Assistant Opium Agent. I have studied chemistry at the Civil Engineering College, Sibpur (Calcutta), and wish to keep myself in touch with current literature, and, more particularly, with modern developments of the chemistry of alkaloids.

Paul Brühl.	William Tate.
E. R. Watson.	*P. C. Ray.*

David Hooper.

Rennie, Alexander,

Johannesburg, Transvaal.

Chemist, Druggist, and Pharmacist (Transvaal). Ex-President of the Pharmaceutical Society of the Transvaal, Member of the Pharmaceutical Society of Great Britain, Queen's Prizeman and Holder of three First-Class Certificates in Chemistry, Science, and Art Department, London, &c.

Walter C. C. Pakes.	Thos. William Dukes.
B. Owen Jones.	*J. A. Wilkinson.*

Peter MacEwan.

Rhead, Ezra Lobb,

Stonycroft, Polygon Avenue, Levenshulme.

Lecturer on Metallurgy, Municipal School of Technology, Manchester, and author of (I) "Metallurgy, an Elementary Textbook"; (II) Assaying and Metallurgical Analysis" (Rhead and Seaton); (III) "The Art and Practice of Ironfounding" [In the Press]; (IV) "Papers Dealing with the Introduction and Removal of Sulphur from Iron; Loss in Estimation; and on other Metallurgical Subjects"; (V) "The Estimation of Copper by Titanous Chloride."

William J. Pope.	Jas. Grant.
W. H. Perkin, jun.	R. L. Taylor.

S. J. Peachey.

Roach, William Frothingham,

Royal Mersey Yacht Club, Rock Ferry, Cheshire.

Medical Officer, Colonial W. African Service. Doctor of Medicine, and Master of Surgery, University Bishop's College, Montreal; Licentiate Apothecaries' Hall, Dublin; Pharm. Chemist Montreal

College of Pharmacy; Member Ph. Assn. Prov. of Quebec; 3 years student under Dr. Harrington McGill doing analysis.

David Sommerville. Rhys P. Charles.
T. H. Byrom. J. T. Ainslie Walker.
Samuel Rideal.

Salamon, Maurice Salamon,

64, Oxford Gardens, N. Kensington.

Student. Intermediate Science, London, 1906. Student at University College for 4 years.

J. Norman Collie. N. T. M. Wilsmore.
William Ramsay. Edward C. Cyril Baly.
R. H. Aders Plimmer.

Saunderson, William,

The Armidale School, Armidale, New South Wales.

Science Master at the above school. Bachelor of Science of Durham University; Science Master at Langport Grammar School, Somerset, Leathersellers' Company Colfe Grammar School, extending over a period of seven years.

P. Phillips Bedson. F. C. Garrett.
J. A. Smythe. *S. Hoare Collins.*
C. Harold Oxland.

Sommerfeldt, Dr. Ernst,

4, Pollock Street, Calcutta.

Universitäts-Professor. Dr. Ph. in Chemistry, Phys., and Miner. at Göttingen, Germany). Co-editor of the periodical *Zeitschrift f. wissenschaftl. Mikroscopie,* Leipzig.

Edward C. Cyril Baly. N. T. M. Wilsmore.
W. H. Pearson. J. W. Swan.
J. E. Stead.

Tate, Francis George Henry,

Kilmersdon, Homecroft Road, Sydenham, S.E.

Assistant Analyst in the Customs Branch of the Government Laboratory, Two years' training in Chemistry at the Royal College of Science, 1900–1902. Worked as an Assistant Analyst in the Customs Branch of the Government Laboratory since 1902.

T. E. Thorpe. William A. Tilden.
J. Connah. G. T. Morgan.
Thos. J. Cheater. M. O. Forster.

Thomas, Frank Moreton,

290 Rotton Park Road, Edgbaston, Birmingham.

Stores Superintendent, c/o Messrs. Belliss and Morcom, Ltd. Mechanical and Electrical Engineers, Birmingham. Author of the following papers, read before the Metallurgical Society and the British Foundrymen's Association at Birmingham, and printed in the journals named: "Pig-iron in its Commercial Aspects" (*Iron and Coal Trades Review*); "Properties of Steel" (*Mechanical Engineer*); "Selection and Testing of Foundry irons" (*Castings*, and *Mechanical Engineer*). Contributor of a series of technical articles to *Birmingham Technical School Magazine*. Member of Iron and Steel Institute. Member of Council, Metallurgical Society, Birmingham. Honours Certificate City and Guilds of London Institute, "Iron and Steel Manufacture," etc.

Thomas Turner. Douglas Twiss.
Henry Silvester. A. E. Bond.
Lionel M. Jones.

Walton, Sidney Gilbert,

"Kensington," Northwood Road, Northwood, Lane Cove River, N.S.W.

Assistant Analyst, Government Laboratory, Department of Public Health, Sydney. For five years I was Junior Assistant to the late Dr. Helms, Analyst of Sydney, after which I studied Chemistry for three years at the University of Sydney, taking a special course in Food and Drug Analysis, and was later appointed Junior Demonstrator in Chemistry, which position I resigned for the purpose of taking up my present duties. During the last two years I have been Assistant Examiner at the Annual Examinations in Chemistry at the University of Sydney. A paper on the Composition of Chocolate Shale and of Tufaceous Sandstone from the Narrabeen Series was contributed by me, and read by Prof. Liversidge, M.A., F.R.S., &c., before the Royal Society, on December 5th, 1906.

William M. Hamlet. Henry G. Smith.
W. M. Doherty. F. B. Guthrie.
J. A. Schofield.

Watt, Robert Dickie,

Pretoria, Transvaal (P. O. Box 434).

Acting Chief Chemist to the Transvaal Department of Agriculture. M.A. degree (Glasgow) 1903. B.Sc. (in Agric.) degree (Glasgow) 1905. 1905—07, Carnegie Research Scholar. Worked at Rothamsted, Herts. Publication, "On the Gas Evolved on Churning," in Journal

Agric. Science, Vol. II. No. I. 1907. Assistant Chemist, Transvaal Department of Agriculture, 1908. Acting Chief, ditto.

A. D. Hall. E. J. Russell.
N. H. J. Miller. *J. Augustus Voelcker.*
Bernard Dyer.

Weighell, Arthur,

Top Floor, Prince Building, Medows Street, Fort, Bombay.

Analytical Chemist. Four years Student at Rutherford College, Newcastle-on-Tyne. Five years with Messrs. J. & H. S. Pattinson, Newcastle-on-Tyne, as Assistant. Eight months with Messrs. Edwd. Riley & Co., Bombay, as Assistant. At present in partnership with Mr. A. S. Lindley, Bombay, as Analyst.

Claude S. Fawcitt. J. T. Dunn.
John Pattinson. *A. W. Comber.*
Edwd. Riley.

Williams, Frederick,

Bute Villa, Aberdare, S. Wales.

Chemistry Master at the Secondary School, Ferndale, S. Wales. B.A. (Oxon.). Honours in Chemistry, Final Honour School, 1907.

Andrea Angel. J. E. Marsh.
H. B. Baker. W. W. Fisher.
John Watts.

Winterson, William George,

89, Salisbury Road, Barnet.

Chemical Assistant, under Dr. McGowan, to the Royal Commission on Sewage Disposal. B.Sc. (Lond.) Chem. Hons., 1905. Joint author with Mr. E. S. Kitchen, of paper, "Malacone, a Silicate of Zirconium containing Argon and Helium," *Trans., Chem. Soc.*, 1906, vol. 89. Engaged, since June, 1906, under Dr. McGowan, in the Chemical work of the Royal Commission on Sewage Disposal, and in other analytical work.

George McGowan. N. T. M. Wilsmore.
William Ramsay. J. Norman Collie.
R. W. Gray.

Wootton, William Ord,

159 Maidstone Rd., Rochester.

Assistant Demonstrator in Chemistry Royal College of Science, London. B.Sc., (Lond.). Honours in Chemistry. A.R.C.Sc. (First Class). Part author with Dr. G. T. Morgan, F.I.C., of papers published in the Journal of the Society 1905—1907. Author of a paper on

"Aromatic Amides and Imides of Camphoric Acid" (*Trans. Chem. Soc.*, 1907, vol. 92).

William A. Tilden. G. T. Morgan.
M. O. Forster. James C. Philip.
Chapman Jones.

Worley, Frederick Palliser,

Mansfield House, Clifton Gardens, Maida Hill, London, W.

Research Student of Chemistry (City and Guilds of London Institute, Central Technical College). Graduate of New Zealand University, M.A., M.Sc. First Class Honours in Chemistry. Paper on "Bromide in Solutions of KBr·Ag," published in the *Journal of the Chemical Society*, 1905 (pp. 1107—1123).

Henry E. Armstrong. Walter H. Glover.
William Robertson. John Vargas Eyre.
Edward Wheeler.

Wright, Allister MacLean,

Christchurch, New Zealand (P.O. Box 617).

Analytical Chemist (The Christchurch Meat Co., Limited). Five years Analytical Chemist to the Christchurch Meat Co. Author of "The Meat Extracts of New Zealand"; "Spontanous Combustion in Wool"; "Analysis of some New Zealand Coals" (*Journal Soc. Chem. Ind.*); "New Zealand Boned Beef" (*Chem. News*); two papers on "Nitrogen-Fixing Bacteria"; "New Zealand Coals"; "New Zealand Meat Products" (*Trans. N.Z. Inst.*).

George Gray. Geo. M. Thomson.
Robert English. B. C. Aston.
Geo. Bagley.

The following Certificates have been authorised by the Council under Bye-law I (3):

Allen, Thomas Boles,

Medical Faculty, McGill University, Montreal.

Demonstrator of Chemistry. B.A. in Chemistry and Mineralogy, Univ. of Toronto, 1901. M.A., 1907. Assistant in Chemistry Dept. of Chem. Univ. of Toronto, 1906—1907. Demonstrator in Chemistry and Physics, Dept. of Chemistry, Medical Faculty, McGill Univ., Montreal, 1907. Joint author with Prof. W. R. Lang of Paper on "An Improved Form of Apparatus for Estimation of Sulphates and Salts of Barium," *Trans.*, Chem. Soc., 1907. Vol. 91.

W. R. Lang. J. Wallace Walker.
W. Lash Miller. Nevil Norton Evans.

Ba, Maung,

Rangoon College, Rangoon.

Assistant to Science Lecturer, Rangoon College. B.A., Calcutta, 1899. Assistant to Science Lecturer, Rangoon College, since January, 1901. Acts as Assistant Lecturer and Demonstrator in the Laboratory.

M. Hunter. *Thein Kin.*

Bhunsri, Prince Mom Chow,

23, Ashburn Place, London, S.W., or Saraurome Palace, Bangkok, Siam.

Future estate agent to His Royal Highness the Crown Prince of Siam. Associate of the Royal Agricultural College (by examination). Being interested in Agricultural Chemistry.

Edward Kinch. *J. Augustus Voelcker.*
W. W. Cobb.

Krishnayya, H. V.,

Mallesvaram, Bangalore, Mysore, India.

Assistant Chemist, Government Chemical Laboratory. B.A. (Madras). Engaged for the last twelve years in the analysis of rocks and minerals in the Chemical Laboratory at Bangalore.

A. L. F. Lehmann. Morris W. Travers.
Claude S. Fawcitt.

San, Maung U.,

Rangoon.

Assistant to the Chemical Examiner and Bacteriologist to the Government of Burma. Assistant in the Laboratory of the Chemical Examiner, Burma, since June, 1904. At first in charge of the examination of oils, and more recently Chief Assistant on the Medico-legal side of the Laboratory.

M. Hunter. Thein Kin.

Shilstone, Herbert M.,

No 410, South Front Street, New Orleans, La.

Analytical Chemist. Bachelor of Science degree. Nine years' practical experience as Analytical Chemist. Recent Assistant Prof. Chemistry at N.O. College of Pharmacy.

John R. Bovell.

Watt, The Rev. John,

Scottish Churches College, Calcutta.

Professor of Chemistry. M.A., Aberdeen, 1884. A Teacher of Science of several years' standing.

P. C. Rây. J. A. Cunningham.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 11/12/08

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24 **No. 348.**

Thursday, December 3rd, 1908, at 8.30 p.m., Sir WILLIAM RAMSAY, K.C.B., F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Herbert Edwin Cocksedge, B.A., 5, Romola Road, Herne Hill, S.E
Frederick Percy Dunn, B.Sc., Haresfield, Chorley Wood.
Frederic Ferraboschi, B.A., Clare College, Cambridge.
Walter Norman Haworth, M.Sc., Dacca House, Chorley.
Eric Hayward, c/o W. R. Criper, Esq., Konnagar House, Konnagar, Nr. Calcutta.
Robert Ernest Jackson, York Villa, Shepherd's Lane, Dartford.
John Hugh Jeffery, 10, Daysbrook Road, Streatham Hill, S.W.
Joseph Allen Pickard, B.Sc., 3, West Kensington Terrace, W.
David Segaller, 69, Dover Road, Wanstead Park, E.
Reginald Wells Varley, 12, Mill Hill Road, Derby.

A ballot for the election of Fellows was held, and the following were declared duly elected:

Noel Charles Akers.
Thomas Boles Allen, M.A.
Thomas Aubertin, B.A.
Maung Ba, B.A.
Thomas James Baker, D.Sc.
Maurice Barrett.
Prince Mom Chow Bhunsri.
Robert Bickerstaffe.
William Colet Birch, B.A.
William Sudderick Brakes.
Leonard Clement, B.A.
Robert Charles Cowley.
Hugh Cecil Duckworth.
Horace Barratt Dunnicliff, B.A., B.Sc.
Reginald Freeman Easton.

Charles Everitt, M.A.
Henry Fairburn.
Arthur Frank Girvan, B.Sc.
Henry Hamilton Green.
John Griffin, B.A.
John Henry Albert Hebron, B.Sc.
Edward Hinks, B.Sc.
Joseph Albert Hughes.
Thomas Ernest Hull.
James Colquhoun Irvine, D.Sc., Ph.D.
Grove Johnson.
Patrick Anderson Keiller, B.Sc.
Joseph Kenyon, B.Sc.
H. V. Krishnayya, B.A.
Frank William Linch.
Arthur Stanley Lindley.
Gregor MacGregor, M.A., B.Sc.
Frederick Martin Kay Menzies, M.D., F.R.C.P.
William Herbert Miles.
Charles James Millar.
Edward Pigott Minett, M.D., M.R.C.S., L.R.C.P.
Howard Houlston Morgan, B.Sc.
Cyril Lawrence Norman.
Alexander Robert Normand, M.A., B.Sc.
George Edward Pearson.
John William Pearson, B.A.
Frank Perry.
George O'Brien Power.
Alexander Rennie.
Ezra Lobb Rhead.
William Frothingham Roach, M.D.
Maurice Salomon Salomon.
Maung U. San.
William Saunderson, B.Sc.
Herbert M. Shilstone, B.Sc.
Ernst Sommerfeldt, Ph.D.
Francis George Henry Tate.
Frank Moreton Thomas.
Sidney Gilbert Walton.
John Watt, M.A.
Robert Dickie Watt, M.A., B.Sc.
Arthur Weighell.
Frederick Williams, B.A.
William George Winterson, B.Sc.
William Ord Wootton, B.Sc.
Frederick Palliser Worley, M.A., M.Sc.
Allister McLean Wright.

Of the following papers, those marked * were read :

*251. "Double salts of potassium iodide with mercuric iodide and dimercuriodocamphor in organic solvents." By James Ernest Marsh and Robert de Jersey Fleming Struthers.

When an aqueous solution of the compound K_2HgI_4 is shaken with ether, ethyl formate, or some other organic solvents, the salt, $KHgI_3$, is extracted; it separates from its solution in ethyl formate as a heavy oil. In no case was the original salt, K_2HgI_4, dissolved. With camphor, the *double* salt, $KHgI_3,4C_{10}H_{16}O$, was obtained from dilute alcohol in light yellow, gritty crystals melting at 65°.

Potassium iodide and dimercuriodocamphor, $C_{10}H_{14}OHg_2I_2$, also form a *double* salt readily soluble in acetone or alcohol, although the two constituents are separately very sparingly soluble.

*252. "The action of mercuric iodide on ketones in alkaline solution." By James Ernest Marsh and Robert de Jersey Fleming Struthers.

Acetone reacts with mercuric iodide in cold aqueous potassium hydroxide according to the equation :

$$C_3H_6O + 8HgI_2 + 6KHO = C_3OHg_5I_4 + 3K_2HgI_4 + 6H_2O.$$

Diethyl ketone reacts mainly according to the following equation :

$$(C_2H_5)_2CO + 6HgI_2 + 4KHO = (CH_3{\cdot}CHg_2I_2)_2CO + 2K_2HgI_4 + 4H_2O.$$

Acetophenone reacts as follows :

$$C_6H_5{\cdot}CO{\cdot}CH_3 + 6HgI_2 + 4KHO = HgI,C_6H_5{\cdot}CO{\cdot}CHg_3I_3 + 2K_2HgI_4 + 4H_2O.$$

The ketone mercury compounds form yellow precipitates. Both the yield and the composition of the precipitates agree with the equations given. In the case of acetone and diethyl ketone, standard alkali was used, and the amount converted into potassium iodide was determined. This amount also agrees with the above equations. The reaction thus affords a quantitative method for estimating the amount of ketones, either by weighing the precipitate formed, or by determining volumetrically the amount of alkali neutralised in the reaction.

*253. "The condensation of camphor with mercuric iodide." By James Ernest Marsh and Robert de Jersey Fleming Struthers.

The following series of mercury camphor derivatives has been obtained :

(*A*) $(C_{10}H_{15}OHg)_2O$, and its salts ; (*B*) $C_{10}H_{14}OHg_2I_2$; (*C*) $(C_{10}H_{14}O)_2Hg_3O$; (*D*) $(C_{10}H_{14}O)_3Hg_4I_2$; (*E*) $(C_{10}H_{14}O)_4Hg_5I_2$; (*F*) $(C_{10}H_{14}O)_5Hg_6I_2$.

Of these compounds, *B*, *D*, *E*, and *F* are formed directly by the action of mercuric iodide on camphor in the presence of alkali. *B* is formed by the action of potassium ethoxide in alcoholic solution on camphor and mercuric iodide in the cold.

D is formed in a hot aqueous solution of potassium hydroxide containing excess of potassium iodide.

E is formed in a similar way with just sufficient potassium iodide to retain the mercuric iodide in solution.

F is formed when there is a defect of potassium iodide.

B is formed from *D* or *E* by the prolonged action of hot potassium hydroxide until all the iodine is removed.

Glacial acetic acid converts *D* into the *compound*, $C_{10}H_{14}OHg_2I_2$, which is insoluble, and the acetate of mercury camphor, which dissolves. From the latter, the base *A* is separated by the action of sodium hydroxide. The base forms salts, of which the *benzoate*, *sulphate*, *chloride*, *bromide*, and *iodide* have been prepared.

DISCUSSION.

Dr. M. O. FORSTER inquired whether definite products had been obtained by the dry distillation of these derivatives of camphor, some of which might be expected to yield dehydrocamphor; also whether any therapeutic value had been observed in connexion with them.

Mr. MARSH replied that the compound $C_{10}H_{14}OHg_2I_2$ could be sublimed without decomposition, and that the other compounds decomposed, but the products formed had not been examined.

The material used in the experiments was the ordinary dextrorotatory camphor; the therapeutic and physiological action of the compounds had not yet been investigated.

*254. "The relation between absorption spectra and chemical constitution. Part XIII. Some pyrones and allied compounds." By Edward Charles Cyril Baly, John Norman Collie, and Herbert Edmeston Watson.

The absorption spectra of dimethylpyrone, chelidonic acid, xanthochelidonate, ethyl diacetylacetone, and several other substances have been examined in considerable detail. In many cases the spectra vary with the solvent used, and consequently it seems probable that these compounds can exist in more than one form. Diacetylacetone in particular may be either an open-chain compound or one with a ring formation.

The pyrones and their simpler derivatives appear to contain an oxygen bridge, the atom of oxygen in the ring being quadrivalent. This bridge is broken by the addition of a sufficient quantity of alkali, intermediate compounds being sometimes formed.

*255. "Organic derivatives of arsenic. Part I. Dicamphorylarsinic acid." By Gilbert T. Morgan and Frances M. G. Micklethwait.

Dicamphorylarsinic acid, $HO{\cdot}OAs(C_{10}H_{15}O)_2$, colourless, prismatic crystals, m. p. 266°, $[\alpha]_D$ 186·6°, is precipitated by acids from an alkaline extract of the product of the interaction of arsenious chloride and sodium camphor in toluene. Its *silver* salt, $AgO{\cdot}OAs(C_{10}H_{15}O)_2$, is a white, sparingly soluble substance, whereas its alkali salts dissolve readily either in water or alcohol. The acid is hydrolysed into camphor (2 mols.) and alkali arsenate (1 mol.), but only when its solution in aqueous caustic alkalis is evaporated almost to dryness.

When treated with phosphorus pentachloride, the acid gives rise to a *chloride*, from which the *anilide* may be obtained.

The authors are engaged in a study of the reactions occurring between the chlorides of the non-metals and organic compounds containing the characteristic group $CH_2{\cdot}CO$.

DISCUSSION.

Dr. LOWRY said he had gathered from the title that the compounds to be described were derivatives of camphoric acid. The use of the term "camphoryl" in this sense had been rendered inevitable by the analogy of "acetyl," "benzoyl," "carbonyl," etc., and had been so generally recognised that no alternative name had hitherto been suggested. The use of the same term for the camphor radicle $C_{10}H_{15}O$ was bound to lead to confusion, and it was very desirable that some distinguishing name should be adopted for this group. Camphor derivatives had usually been named by means of prefixes, but the case of "camphocarboxylic acid" suggested an alternative usage: could not the arsenic compound be described by an analogous name as "dicamphoarsenic acid"?

Dr. M. O. FORSTER defended the use of the expression "camphoryl" for the complex $C_{10}H_{15}O$, and invited Dr. Lowry to formulate "dicamphorylarsinic acid" on his assumption that camphoryl should stand for the radicle of camphoric acid.

In reply to Dr. Pyman, Dr. MORGAN said that they had not hitherto obtained the corresponding arsonic acid from the products of this condensation. With reference to the question of nomenclature raised by Dr. Lowry, it seemed to the authors that the prefix "camphoryl" was a suitable one to use for this acid, in which opinion they had the support of other investigators of camphor derivatives.

*256. "Tellurium dicyanide." By Herbert Edwin Cocksedge.

When tellurium tetrabromide and silver cyanide are heated together for some days in boiling benzene, tellurium dicyanide is formed.

On extracting the residual silver salts with ether, and evaporating the ether at the ordinary temperature, white crystals of the composition $2Te(CN)_2,(C_2H_5)_2O$ are obtained. By heating these and subliming the product in a vacuum, the pure *dicyanide*, $Te(CN)_2$, results in the form of white crystals.

The compound is partly decomposed by heat, giving cyanogen and tellurium. It is at once hydrolysed by water, with precipitation of black flocks of tellurium.

*257. "Boron thiocyanate." Herbert Edwin Cocksedge.

Boron thiocyanate, $B(SCN)_3$, is prepared by the action of boron bromide on silver thiocyanate in cold benzene solution. On evaporation of the solvent at the ordinary temperature, colourless crystals remain.

The compound resembles the corresponding thiocyanates of phosphorus and silicon in general reactions, but decomposes readily on heating. The action of aniline on the compound in benzene solution points to the thiocyanate constitution.

*258. "The viscosity of fuming sulphuric acid." By Albert Ernest Dunstan and Robert William Wilson.

The authors have investigated the viscosity-concentration curve afforded by various mixtures of sulphuric acid and sulphur trioxide. They find a maximum point at the concentration corresponding with H_2SO_4,SO_3.

DISCUSSION.

Dr. SENTER said that the maxima in the curves for binary mixtures obtained by plotting viscosity against composition were usually somewhat difficult to interpret. Both sulphuric acid and water appeared to exist as very complex molecules in the pure state, and it was probable that both of them were in a simpler molecular condition when mixed. He wished to ask Mr. Dunstan how, in his opinion, the viscosity curve would be affected by a progressive simplification of the molecules of the components on dilution. If it was assumed that, owing to the increased surface of the particles, the effect of this simplification was to increase the viscosity, the maximum in certain binary mixtures of associated liquids (for example, alcohol and water) could be accounted for without assuming that the components enter into chemical combination. On the other hand, independent evidence pointed to the existence of chemical compounds in mixtures of sulphuric acid and water, and the latter system was therefore very complicated.

Mr. DUNSTAN, in reply to the President, agreed as to the advisability of determining the molecular surface energy of the mixture, the composition of which approximated to H_2SO_4,SO_3; in answer to Dr. Senter, he said that there were two explanations to the maximum points in viscosity-concentration curves; Jones and Veazey (*Amer. Chem. J.*, 1907, **37**, 405) have asserted that such maxima are due to dissociation, that is, by the proportionally larger frictional surfaces of smaller molecular masses, but he himself contended that in the first place the maxima correspond with aggregates of simpler molecular composition, that such aggregates have actually been isolated, and that heat effects and many other physical properties attain their maxima at the same points. The argument as to larger frictional surfaces only held good if it were definitely known that the aggregates are regular in shape and smooth in surface.

Moreover, since associated substances were proportionately more viscous than non-associated compounds, he considered that the action of the sulphuric acid on the water (and vice versa) was (1) simplification of the homogeneous aggregates, and then (2) association of these products.

259. "The decomposition of carbon dioxide by the silent electric discharge." By Alfred Holt, jun.

Carbon dioxide, which had been carefully dried by phosphoric oxide, was found to be decomposed to an amount which increased as the pressure of the gas diminished. About 48 per cent. decomposition was obtained under 30 mm. pressure, and about 3 per cent. decomposition under 700 mm. pressure.

The amount of decomposition was found to vary with the degree of dryness of the gas, the intensity of the discharge, and the form of ozoniser employed, but in all cases diminished pressure gave greater decomposition.

Moist carbon dioxide was found to decompose to a larger extent as the pressure of the gas increased, ranging from 3 per cent. decomposition under 50 mm. pressure to about 14 per cent. under 700 mm. pressure. The weaker the discharge the less gas was decomposed at all pressures.

Comparison of these results with those obtained when moist and dry carbon dioxide is decomposed by ultra-violet light, or induction sparks, leads to the conclusion that the silent discharge at low pressures acts chemically, mainly like ultra-violet light, whilst as the pressure of the gas increases, it behaves more and more as though it consisted of actual sparks.

260. "Note on oxalyl chloride."

By Humphrey Owen Jones and Hubert Sanderson Tasker.

The authors' investigations on the properties and reactions of oxalyl chloride had been in progress some months when a paper on the same subject was published by Staudinger (*Ber.*, 1908, **41**, 3558). It was found, in agreement with Staudinger, that the yield of oxalyl chloride obtained by Fauconnier's method, namely, by the action of phosphorus pentachloride on ethyl oxalate, is very poor, but the yield can be enormously increased by carrying out the reaction at 160° under pressure.

It was found impossible to free the oxalyl chloride entirely from phosphorus compounds by distillation, as the process is rendered more difficult by the presence of *as*-dichloroethane among the products. The amount of phosphorus trichloride formed is small, and the chief product is phosphoryl chloride; ethyl chloro-oxalate and ethyl trichloroacetate are formed in large quantities.

The major portion of the oxalyl chloride distils at about 70°, and then contains about 3 per cent. of phosphoryl chloride. Oxalyl chloride reacts vigorously with water, and yields some oxalic acid, together with carbon monoxide and carbon dioxide, whereas Staudinger states that oxalic acid is only obtained when the vapours react.

Oxalyl chloride reacts vigorously with primary and secondary amines to produce substituted oxamides, whereas with tertiary amines it forms additive products. The *additive* compound with pyridine, $C_2O_2Cl_2,2C_5H_5N$, is a white solid, which reacts with water to give pyridine hydrochloride with carbon monoxide and dioxide, and no oxalic acid; it reacts with primary or secondary bases to give pyridine hydrochloride and substituted oxanilides. This is a better method of preparing these substances than by using the chloride direct. The compounds formed with tertiary amines resemble closely the corresponding compounds obtained from carbonyl chloride.

The authors are at present engaged in examining the reactions of oxalyl chloride on a number of substances, chiefly derivatives of organic metallic compounds.

261. "The densities of krypton and xenon." By Richard B. Moore.

The author has prepared pure xenon and krypton from the residues from 120 tons of liquid air. The density of xenon was found to be 65·35, and that of krypton 41·506, the atomic weights being, on the assumption that the gases are monatomic, 83·012 and 130·70 respectively ($O = 16$).

262. "The action of reducing agents on tannic and gallic acids." By Walter Myers Gardner and Herbert Henry Hodgson.

The object of the work was to devise a rapid and accurate method for the estimation of tannic and gallic acids, and it was thought that a quantitative yield of benzoic acid might be obtained on reduction.

Previous work on the action of reducing agents on these acids had been published by Böttinger (*Annalen*, 1890, **258**, 252) and Guignet (*Compt. rend.*, 1891, **113**, 200). The former obtained no reduction products, but using different conditions Guignet found that both tannic and gallic acids were converted into benzoic acids.

The authors have repeated Guignet's work, but obtained a very poor yield of benzoic acid. In the further work, the following were tried as reducing agents: zinc, sodium, magnesium, aluminium, sodium hyposulphite, and hydriodic acid; experiments being made in most cases under acid, alkaline, and neutral conditions. The general results were that tannic and gallic acids are little affected by neutral or acid reducing agents, but that they react readily in alkaline solution. In no case, however, was a quantitative yield of benzoic acid obtained, and this was shown to be due to the slow destruction of benzoic acid by alkaline reducing agents.

The original object of the investigation was therefore not attained, but several interesting observations were made.

263. "The action of iodine on phenols and a modified process for the estimation of tannic acid." By Walter Myers Gardner and Herbert Henry Hodgson.

In the preceding paper, the authors have shown that tannic acid in alkaline solution rapidly reacts with reducing agents, and, based on this observation, a quick and accurate method for the estimation of tannic acid has been developed. The process is carried out as follows: To an aqueous solution of tannic acid, standard iodine solution is added in excess. Aqueous sodium hydroxide is then added drop by drop until the colour due to the iodine disappears, after which concentrated hydrochloric acid is added in sufficient excess to precipitate the unabsorbed iodine, the amount of which is estimated by standard sodium thiosulphate. Two estimations are necessary in the case of commercial tannins. Firstly, that of the total iodine absorbed, and secondly, that of the iodine absorbed after removing the tannic acid from the solution by precipitation with gelatin; the difference giving the iodine absorbed by the tannic acid. Previous work by Messenger and Nortmann (*Ber.*, 1890, **23**, 2753), F. Musset (*Chem. News*, 1885, **51**, 42), and A. Moullade (*J. Pharm. Chim.*, 1905, **22**, 153) on somewhat similar lines has been repeated, and it has been further shown that the process is available for the estimation of many phenols, for example, phenol, catechol, quinol, salicylic acid, pyrogallic acid, and gallic acid, in addition to tannic acid. With these substances, the amount of iodine absorbed is in direct ratio to the number of hydroxyl groups present, one hydroxyl group requiring one molecule of iodine; but with other phenols the reaction, although quantitative, is empirical. The presence of other groups, such as NO_2, NH_2, OMe, as well as the position of the hydroxyl groups in the benzene nucleus, was found to have a determining influence on the course of the reaction. Following Wijs's investigations on the action of Hübl's solution, the authors think that the active substance is the hypoiodate formed, but they are further investigating this assumption.

264. "Ester catalysis and a modification of the theory of acids."

By Edward Fitzgerald and Arthur Lapworth.

The previous observations on esterification and ester hydrolysis in acetone already referred to (*Proc.*, 1908, **24**, 152, 153) have been confirmed and extended.

If it be assumed that hydrogen ions are responsible for acid catalysis in esterification and ester hydrolysis, the authors find it possible to explain the facts on one proposition only, namely, that the addition of water to a solution of an acid in acetone or alcohol greatly diminishes the number of hydrogen ions, the alternative theories—that the intermediate products are shared between the alcohol and water, or the view applied by Arrhenius to the hydrolysis of salts of weak bases—having proved inadequate.

It would then appear that the proportion of hydrogen ions in an aqueous solution of hydrogen chloride must be extremely small, and this makes it seem probable that they are not altogether indispensable to a satisfactory theory of acids.

The hydrated hydrogen ion or hydroxonium ion, $H_3^{\cdot}O$, often assumed to be the conducting positive ion in aqueous solution of acids, is, in this conception, inert as a catalyst, so that these suggestions are not only at variance with the Arrhenius-Ostwald view of connexion between conductivity and reactivity, but are essentially opposed to theories of hydrion catalysis in which the hydroxonium ion is regarded as catalytically active (compare Goldschmidt and Udby, *Zeitsch. physikal. Chem.*, 1907, **60**, 731).

In most physical measurements the hydrogen ions proper may be neglected, and the above theory virtually takes the form that the anticatalytic effect of water on catalysis by acids is due to the fact that water in the same sense as ammonia is a more powerful base than the solvent and, usually, the substance catalysed, and diminishes the available free acid by converting it into hydroxonium salt.

265. "An examination of the conception of hydrogen ions in catalysis, salt formation, and electrolytic conduction." By Arthur Lapworth.

Small quantities of water depress the catalytic effect of acids on the bromination of acetone and on the hydrazobenzene conversion in alcohol and other solvents in just the same way as in the case of esterification (Goldschmidt) and the decomposition of ethyl diazoacetate (Bredig). Water, to the extent of 0·5 per cent. in acetone itself, depresses the velocity with which it absorbs bromine under the influence of acids to considerably less than one-half of its original value.

Proceeding from the most generally accepted view that free hydrogen ions are responsible for catalysis by acids, a strict mathematical expression applying to the state of an acid in a medium is easily developed. By means of this it is not difficult to show that all the generalisation of Ostwald and Arrhenius applying to the variations of conductivity and catalytic activity with volume and the measured degree of dissociation will be as true when the medium consists of, or contains, a mixture of bases as when it is neutral; further, that all acids at infinite dilution in a given medium will exhibit the same equivalent catalytic activity. But this is mathematically true when the hydrogen ions in all cases are then made $= 0$.

In order to connect these conclusions with the basic properties of common oxygenated solvents, a simple indicator method has been devised. The phenomena observed with water on the indicator salt in alcohol, simulate closely the effects of water on acid catalysis. Using this process in several media, Mr. R. W. L. Clarke reports, as a first approximation to the real relative affinities of some weak bases: carbamide, 17; water, 1; ether, 0·12; ethyl alcohol, 0·06. The values are fairly concordant amongst themselves, and are of the expected order.

At the next Ordinary Meeting on **Thursday**, December **17th**, 1908, at **8.30** p.m., the following papers will be communicated :

''Silicon researches. Part XI. Silicotetrapyrrole." By J. E. Reynolds.

"Silicon researches. Part XII. Action of silicochloroform on potassium pyrrole." By J. E. Reynolds.

"Silicon researches. Part XIII. Silicon halides and pyridine, acetonitrile, etc." By J. E. Reynolds.

"The affinity values of tropine and its derivatives." By V. H. Veley.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 24 No. 349.

Thursday, December 17th, 1908, at 8.30 p.m., Sir William Ramsay, K.C.B., F.R.S., President, in the Chair.

On the question of admitting women to the Fellowship of the Chemical Society, the President was desired by the Council to make the following statement:

As already announced, the recent ballot on this question showed that of those among the 2900 Fellows of the Society who voted, 1094 were in favour of, 642 opposed to, the admission of women to the full rights and privileges of Fellowship. Consequent on this difference of opinion three considerations presented themselves.

(1) In 1904 the opinion of Counsel was taken as to the eligibility of women for Fellowship under the existing Charter, and your Council was advised that married women are certainly excluded, whilst the position of unmarried women is extremely doubtful, and that it would not be wise to admit women to Fellowship without first applying for a Supplemental Charter. Such a course would involve the Society in considerable expense unless, as has been suggested, the cost were met in part by the petitioners; moreover, your Council was advised on a previous occasion when application for a Supplemental Charter with another object in view was under discussion, that in the opinion of Counsel it was "highly improbable that the Government department before whom the application must come would be disposed to listen to the application unless it represented the practically unanimous vote of the Fellows, and that any active

opposition by even a small minority would probably be fatal" (*Proceedings*, 1898, p. 38).

(2) Assuming, however, that a successful application for a Supplemental Charter were made, and a certificate of candidature on behalf of a woman were presented, the ballot, if reflecting the above-mentioned figures, would result in the rejection of the candidate, because at least three-fourths of those voting must be in favour.

(3) Your Council might accord to women the privilege of using the Library and attending the meetings, and allow them to purchase the publications of the Society at approximately cost price.

After mature deliberation your Council has decided by a considerable majority that it would remove some of the disabilities experienced by women chemists if the following resolution were adopted.

"That in the opinion of this Council it is desirable that, at any time, on recommendation by three Fellows of the Society, women be accepted as Subscribers to the Society. Such women Subscribers shall pay an annual fee of thirty shillings; they shall be admitted to all ordinary meetings of the Society; they shall have the same use of the Library as the Fellows, and they shall be supplied with the Proceedings, Transactions, and Annual Reports of the Society as these are issued."

This resolution has now been adopted.

It was further announced by the President that the Society was once more indebted to Sir Henry Roscoe for a valuable gift of books, comprising 636 volumes. The meeting endorsed with acclamation the vote of thanks already accorded Sir Henry by the Council.

The seventieth birthday of Professor Dr. G. Lunge will be celebrated on September 15th, 1909, and a local committee has undertaken to arrange a suitable commemoration of the occasion; the President stated that those Fellows who desire to show their sympathy with the festival are requested to communicate with Herrn Dr. E. Berl, Zürich IV, Sonneggstrasse 84.

Mr. M. Barrett was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

George Henry Joseph Adlam, B.A., 86, Southmoor Road, Oxford.
Hubert Brunskill, 7, Friarage Gardens, Hartlepool.
John Wilberforce Green, 22, Alwyne Road, Wimbledon.
John Esson McGillvray, M.A., 15, Regent Street, Hartlepool.
William Norton Morley, B.Sc., 325, Brownhill Road, Catford, S.E.

Frederick Hubert Painter, B.Sc., Heatherbank, Alum Chine Road, Bournemouth.
Colston James Regan, 14, Penerley Road, Catford, S.E.
James Thomas Stevenson, 67, Surrey Street, Sheffield.

Of the following papers, those marked * were read :

*266. "Silicon researches. Part XI. Silicotetrapyrrole." By James Emerson Reynolds.

Much of the work recorded in former papers of this series related to the action of silicon halides on aromatic compounds, including the amino-group, or its equivalent, as a side-chain. It was shown that well-defined, crystallised substances could be formed, such as $Si(NH{\cdot}C_6H_5)_4$, in which silicon was obtained for the first time wholly combined with nitrogen. In the course of the study of these substances, it became evident that the inquiry should be carried a stage or two farther, so as to include compounds in which nitrogen forms part of a ring, as in pyrrole and pyridine.

Silicon tetrachloride can be added to pure pyrrole with little effect, but when some light petroleum is poured in, complete mixture is effected and a brown condensation product, containing a small and variable proportion of silicon, separates out. This feeble action of the free base is in strong contrast with the violent interaction of aniline and the silicon compound.

It was found, however, that when potassium pyrrole, C_4H_4NK, was treated with silicon chloride at a low temperature, energetic action ensued, potassium chloride and a crystalline *substance*, in fine needles, which proved to have the composition $Si(NC_4H_4)_4$, being formed. This compound melts at 173° (corr.), but decomposes if heated to a materially higher temperature. Its molecular weight, as determined by the boiling-point method, agrees with the above formula. The substance differs materially from silicophenylamide more especially in the action of heat on it.

*267. "Silicon researches. Part XII. The action of silicochloroform on potassium pyrrole." By James Emerson Reynolds.

As a synthesis of pyridine from pyrrole has been effected by the action of ordinary chloroform on potassium pyrrole, it seemed possible that silicochloroform might yield a silicopyridine, that is, a pyridine ring including SiH instead of one CH group.

Violent action occurs when silicochloroform is added to potassium pyrrole, and the mass becomes dark brown or black, owing to the decomposition of a large proportion of the pyrrole, but nothing definite could be extracted from the residues of several such experiments save some of the tetrapyrrole compound described in Part XI. However, when the materials used were cooled to a very low temperature, the interaction was not so violent, and a small quantity of a dark green liquid was extracted, which did not boil at 210° under a pressure of 50 mm., and decomposed rapidly above that temperature. It proved to consist of $SiH(NC_4H_4)_3$ in a nearly pure condition. When cooled in liquid air, it became a deep bronze-green solid, but rapidly liquefied at the ordinary temperature. It is very easily decomposed in moist air.

Another compound was obtained during the preparation of the tripyrrole derivative ; this is a liquid boiling at about 135°/50 mm., and has the composition $SiH(NC_4H_4)Cl_2$. It is easily decomposed by water, and fumes in the air. Neither this liquid nor the tripyrrole compound exhibits any characters of a silico-nitrogen-carbon ring, but they promise to prove useful in further attempts to form such a cyclic combination.

*268. "Silicon halides and pyridine, acetonitrile, etc. Part XIII."

By James Emerson Reynolds.

It was inferred from the experience obtained with pyrrole that organic substances, including nitrogen wholly combined with carbon, would react feebly, if at all, with silicon halides. A series of experiments has confirmed this view so far as applies to the compounds used, namely, pyridine, acetonitrile, propionitrile, and benzonitrile.

Pyridine gave with silicon tetrabromide the *additive* compound $SiBr_4,2C_5H_5N$, and the chloride yielded a similar substance, which latter was also obtained by Harden. Acetonitrile and propionitrile also gave *additive* compounds of the same order with silicon tetrabromide, and much less easily with the chloride, but benzonitrile did not appear to combine with either.

*269. "The affinity values of tropine and its derivatives."

By Victor Herbert Veley.

It was shown that tropine, the parent base of the atropine and cocaine alkaloids, has a considerably lower affinity value than piperidine, and it was concluded that the stronger piperidine residue is modified by being conjoined to the weaker pyrrolidine residue if the constitution of this base proposed by Willstätter is correct.

Ecgonine, or tropinecarboxylate, possesses all the properties of an amphoteric electrolyte; its nature is in all probability that of an inner anhydride or betaine.

Anhydroecgonine is a stronger base than ecgonine; the affinity value obtained was approximately equal to that of a benzenoid betaine.

Benzoylecgonine in dilute solution does not remain in combination with hydrochloric acid; its basic function is, therefore, of the order of caffeine.

Cocaine is a relatively strong base, although weaker than ammonia; the effect produced by the substitution of the carboxylic hydrogen by the methyl group is analogous to that previously observed in the case of glycine.

The affinity value of cocaine was found to be approximately $k_b = 2{\cdot}5\ 10^{-7}$, by determining the mass of sodium hydroxide, contained in a hydrolysed borax solution, which was required to upset the equilibrium between a certain mass of cocaine combined with hydrochloric acid as a dissolved salt.

The tropeines, atropine and homatropine, have affinity values greater than $k_b = 1\ 10^{-7}$; it appeared that when aqueous solutions of their hydrochlorides are heated for some time to their boiling point, no conversion of the lactonic group into the corresponding hydroxycarboxylic acid takes place.

*270. "Hydroaromatic ketones. Part I. Synthesis of trimethyl*cyclo*hexenone (*iso*phorone) and some homologues." By Arthur William Crossley and Charles Gilling.

Further investigation of the trimethyl*cyclo*hexenone obtained by the interaction of ethyl malonate and chlorodimethyl*cyclo*hexenone (*Proc.*, 1908, **24**, 130) has proved it to be identical with *iso*phorone.

This method for preparing hydroaromatic ketones has been extended by using substituted malonic esters, but, unfortunately, the yields of the initial condensation products become smaller with increase in the molecular weight of the substituting group. Thus while it has been found possible to prepare *dimethylethyl-* and *dimethylpropyl-*cyclo*hexenones*, only traces of a condensation product could be isolated from the interaction of chlorodimethyl*cyclo*hexenone and ethyl *iso*propylmalonate, and the method would not, therefore, appear to be of any practical utility for the preparation of the higher members of the series.

*271. "Note on the determination of the rate of chemical change by measurement of the gases evolved." By John Cannell Cain and Frank Nicoll.

The authors showed that the criticism of their work on the rate of decomposition of diazobenzene chloride, advanced by F. E. E. Lamplough in a paper bearing the above title and read before the Society in 1906 (*Proc.*, **22**, 280; compare also *Proc.*, 1908, **24**, 29) and recently published in full (*Proc. Camb. Phil. Soc.*, 1908, **14**, 580), are invalid for the following reasons: (1) It is definitely stated in their paper (*Trans.*, 1902, **81**, 1415) that "the flask usually contained pieces of broken glass for purposes of adjustment, and was well shaken during this operation (of heating the diazo-solution to the required temperature) to avoid overheating," and hence supersaturation was impossible. (2) The whole of the calculated amount of nitrogen was measured; hence none was retained by the solution beyond the minimum quantity (which is within the limits of experimental error) ordinarily dissolved.

Moreover, it was pointed out that Lamplough has overlooked Euler's proof that the reaction is accelerated by colloidal platinum, for in the experiments on the decomposition of hydrogen peroxide the platinum stirrer was coated with wax to guard against any possible action of the platinum, whilst this precaution was omitted in the experiments on diazobenzene chloride. This may well account for the higher value of the constants obtained. Further, Euler has proved by experiment that no supersaturation of the solution with nitrogen takes place in the decomposition of the diazo-solution (*Annalen*, 1902, **325**, 295). Finally, the authors expressed the opinion that Lamplough's method of measuring the value of constants which vary enormously with the temperature (being multiplied three to four times for a difference of 10°), by omitting to carry out his experiments with a thermometer in the reacting liquid, and by heating the diazo-solution "one or two degrees higher than (the temperature of) the water-bath," which again would raise the value of the constant found, cannot be regarded as an exact one, and the conclusion was drawn that the authors' determinations of the values of the constants in question (in which the temperature was carefully maintained at the correct point) are to be looked upon as being the most accurate yet recorded.

Discussion.

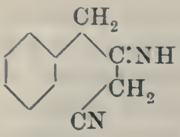
Dr. Senter said he did not think that Dr. Cain's solution could have been appreciably supersaturated under the conditions of experiment.

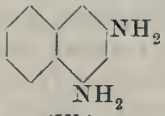
In his experience, however, solutions in which gases were generated might become highly supersaturated under certain conditions. In the course of an attempt to determine the rate of decomposition of hydrogen peroxide by highly diluted blood (1 of blood to 500 of water) by measuring the oxygen liberated (compare *Zeitsch. physikal. Chem.*, 1903, **44**, 257), it was found that if the reaction was allowed to proceed quietly for some time, and the bottle was then vigorously shaken, an immediate increase in the volume of the oxygen, amounting to several c.c., was observed, although, as shown by subsequent investigation, the course of the reaction is perfectly regular. The amount of oxygen held in solution before shaking amounted at least to five times the ordinary solubility of the gas, and could not be due to chemical combination with the constituents of the blood (1) because of the exceedingly small proportion of blood present (under ordinary conditions blood only takes up about 20 per cent. of its volume of oxygen at atmospheric pressure); (2) because the gas was set free by shaking alone.

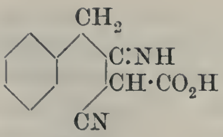
The President remarked that certain colloidal and albuminous substances have a considerable influence in causing their solutions to retain gas in solution: he alluded to the solubility of nitrogen in blood-serum. He understood from Dr. Senter that the subject is being investigated by Dr. Findlay.

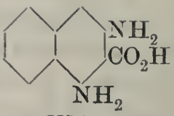
272. "The formation and reactions of imino-compounds. Part VII. The formation of 1:3-naphthylenediamine from β-imino-α-cyano-γ-phenylpropane." By Stanley Robert Best and Jocelyn Field Thorpe.

In order to study the effect of concentrated sulphuric acid on benzenoid imino-nitriles containing no other substituting groups in the side-chain, attempts were made to prepare *β-imino-α-cyano-γ-phenylpropane* (I) by the condensation of phenylacetonitrile with acetonitrile, but without success. It was ultimately found that this substance can be prepared by the action of alcoholic sodium ethoxide on ethyl β-imino-α-cyano-γ-phenylbutyrate, $CH_2Ph\cdot C(:NH)\cdot CH(CN)\cdot CO_2Et$, which yields, in the first instance, *β-imino-α-cyano-γ-phenylbutyric acid* (II), and subsequently, by the elimination of carbon dioxide, the above imino-nitrile. Both β-imino-α-cyano-γ-phenylbutyric acid and β-imino-α-cyano-γ-phenylpropane pass into naphthalene derivatives on treatment with concentrated sulphuric acid, the former into 1:3-naphthylenediamine-2-carboxylic acid (III) and the latter into 1:3-naphthylenediamine (IV):


(I.)


(IV.)


(II.)


(III.)

During the experiments on the conditions of hydrolysis of ethyl β-imino-α-cyano-γ-phenylbutyrate with one equivalent of alcoholic potash, it was found that when methyl alcohol is the solvent used the ethyl salt is completely converted into *methyl β-imino-α-cyano-γ-phenylbutyrate*, $CH_2Ph \cdot C(:NH) \cdot CH(CN) \cdot CO_2Me$, and that when water is present the potassium compound of methyl α-cyano-γ-phenylacetoacetate, $CH_2Ph \cdot CO:CK(CN) \cdot CO_2Me$, is the sole product. Methyl β-imino-α-cyano-γ-phenylbutyrate passes into *methyl* 1 : 3-*naphthylenediamine-2-carboxylate* on treatment with sulphuric acid.

273. "The absorption spectra of para-benzoquinone, quinol, and quinhydrone in the state of vapour and in solution." By Walter Noel Hartley and Alfred Godfrey Gordon Leonard.

The absorption spectra of *p*-benzoquinone and various derivatives in solution were examined by Hartley, Dobbie, and Lauder (*Brit. Assoc. Rep.*, 1902, p. 107), and compared with the various structural formulæ which had been proposed for these substances. The chemical reactions of *p*-benzoquinone were referred to, particularly its powerful oxidising action on alcohols (Ciamician and Silber, *Ber.*, 1901, **34**, 1350), and therefore alcohol had been regarded as an unsuitable solvent. Baly and Stewart (*Trans.*, 1906, **89**, 506) regard water as an unsatisfactory solvent and employ alcohol. They find the curve for *p*-benzoquinone in alcoholic solution to be quite different from that observed by Hartley, Dobbie, and Lauder. Experiments made by one of the present authors, in 1902, seemed to show that both alcoholic and aqueous solutions under the action of light yield quinol, and the band of quinol is indicated on the curves. To ascertain the absorption spectrum of pure *p*-benzoquinone, photographs of the absorption spectrum of its vapour which had been already obtained were compared with those of a solution of the substance in a neutral solvent, such as ether. The results led to an extension of the work to quinol and quinhydrone, in consequence of the discovery of a reversible reaction, expressed in terms of the following equation: $C_6H_6O_2 \rightleftharpoons C_6H_4O_2 + H_2$, when quinol vapour is heated in air to 147° at atmospheric pressures and exposed to light. When heated in hydrogen, the quantity of *p*-benzoquinone produced is diminished.

Among the conclusions arrived at are, that ether is the only suitable solvent at all concentrations, and that under the influence of sunlight, or ultra-violet rays, an interaction occurs between the solvent alcohol and the solute *p*-benzoquinone which leads to the reduction of the latter to quinol or quinhydrone.

274. "The constitution of para-benzoquinone."
By Walter Noel Hartley.

In a previous paper, the author has shown how the formula for benzene as proposed by Kekulé might be reconciled with those of Armstrong and von Baeyer (*Trans.*, 1905, **87**, 1823). From the evidence obtained during the investigation of *p*-benzoquinone, and of benzene and its homologues in a state of vapour (*Phil. Trans.*, 1908, *A*, **208**, 475), it now appears certain that neither *p*-benzoquinone nor quinol has a fixed and settled constitution in the strict sense of their usual symbolic representations, or the interpretations of them. It has been proved that *p*-benzoquinone is a benzene derivative, and furthermore, that it is possessed of a dual character in the sense that the function of the molecule can be either that of a double ketone or of a peroxide, according to circumstances. The reversible reaction described in the previous paper by Mr. Leonard and the author is now under further investigation.

275. "Benzyl sulphoxide: a possible example of dynamic isomerism." By John Armstrong Smythe.

By the action of hydrochloric acid on benzyl sulphoxide, four to six of the following compounds are produced: benzaldehyde, benzyl chloride, benzyl mercaptan, benzyl disulphide, benzyl sulphide, benzyl disulphoxide, and benzaldehyde benzylmercaptale. The study of this reaction under different conditions has shown that it is influenced by temperature, and the nature of the solvent in which it takes place; the oxygen of the sulphoxide passes over chiefly into the disulphoxide in aqueous solvents, but progressively larger amounts of benzaldehyde are formed as the solvent becomes more anhydrous and the temperature rises.

To account for these and allied phenomena, it is assumed that benzyl sulphoxide exists in solution in two forms, which differ constitutionally in the position of the oxygen atom in the molecule. On the basis of this hypothesis, a series of equations involving the tautomeric forms is proposed, which gives a simple and consistent account of the formation of all the various products, and enables the hypothesis to be tested by comparison of the quantities calculated from the equations with those found experimentally. The agreement of calculated with experimental results is held to justify the hypothesis.

The quantitative data enable further the equilibrium between the tautomerides under certain conditions to be investigated, and they also show the influence of water as catalyst in the conversion of one form into the other.

Confirmatory evidence of these views is obtained from other reactions of benzyl sulphoxide.

276. "The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds. Part III."

By Arthur Slator and Douglas Frank Twiss.

The velocities of the reactions between sodium thiosulphate and the following halogen compounds have been measured: propyl iodide, *iso*propyl iodide, allyl iodide, chloroacetone, chloroacetophenone, benzyl chloride, *o*-, *p*-, and *m*-nitrobenzyl chlorides, ethyl α-bromopropionate, and ethyl α-bromobutyrate. The great activity of the acetone derivatives is remarkable. Allyl iodide is more reactive than methyl iodide. The activity of the benzyl chlorides is of the same order of magnitude as that of methyl chloride. The *iso*-compounds are less reactive than the corresponding normal compounds.

To explain to a certain extent the results of this and other investigations, it is suggested that the halides exist in more than one form in solution, and that some reagents react with one form and some with another.

277. "Note on the optical rotatory power of menthyl cinnamate."

By Thomas Percy Hilditch.

The author's observations on menthyl cinnamate (*Trans.*, 1908, **93**, 1) showed that his specimen of this ester, although identical in most physical properties with those described by Tschugaeff (*J. Russ. Phys. Chem. Soc.*, 1902, **34**, 606) and Cohen and Whiteley (*Trans.*, 1901, **79**, 1308), possessed in chloroform solution a widely different rotation from that given by Tschugaeff for the liquid ester ($[\alpha]_D$ − 86·65°).

An opportunity for further investigation of this point has been afforded by experiments made primarily with the view of ascertaining the degree of accuracy of a polarimeter in the University of Jena; two samples of menthyl cinnamate were prepared, one from cinnamic acid procured from Kahlbaum, and the other from acid prepared by the author from benzaldehyde by Perkin's reaction. The menthol possessed a specific rotation $[\alpha]_D^{15}$ $-48·84°$ in 5 per cent. chloroform solution. The purification of the esters was accomplished, as previously, by two successive distillations in a vacuum; the boiling point of each sample was 210—212°/20 mm.

In 10 per cent. chloroform solution the first preparation had $[\alpha]_D^{15}$ $-60·44°$, and the second $[\alpha]_D^{15}$ $-60·50°$; the value previously obtained with menthol, $[\alpha]_D^{20}$ $-48·40°$, was $[\alpha]_D^{20}$ $-60·00°$. On examining the compound without a solvent, however, the observed optical activity was $[\alpha]_D^{15}$ $-85·95°$.

It was obviously a matter of great difficulty to determine, at the temperature of the experiments, the molecular condition of the ester, either undissolved or dissolved in chloroform. The rotatory power in glacial acetic acid was therefore measured, when a 5 per cent. solution gave $[\alpha]_D^{15}$ $-60·02°$. It may thus be assumed that the molecular state of the substance here is the same as in chloroform. A molecular-weight determination by the freezing-point method in glacial acetic acid solution showed the ester to be unimolecular (0·2204 ester in 26·804 acetic acid gave $\Delta = 0·113°$, whence M.W. = 280·8. $C_{19}H_{26}O_2 = 286$); hence the substance is unimolecular in acetic acid and also in chloroform solution, whilst in the undissolved state it is probably associated. It may be noted that the corresponding menthyl β-phenylpropionate possesses the same rotatory power in the fused state as in chloroform solution.

Similar irregularities have been mentioned by Rupe (*Annalen*, 1903, **327**, 164) in the case of menthyl acetate, which possesses less activity in alcohol solution than when no solvent is used, although all the other menthyl fatty acid esters show greater optical activity in alcohol than in the absence of solvent, and by Freundler (*Compt. rend.*, 1893, **117**, 556; *Ann. chim. phys.*, 1895, [vii], **4**, 244), who showed that ethyl alcohol, methyl alcohol, and acetone solutions of dipropyl diacetyltartrate have a weaker rotatory power than the undissolved substance, whilst dipropyl dibutyryl- and dihexyl-tartrates possess stronger activity in these solvents than in the undissolved state.

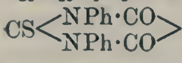
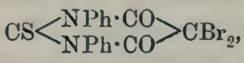
It follows from the above results that such esters are not in the same molecular condition when undissolved as when in solution, and that any measurements designed for the purpose of comparing the rotatory powers of a series of substances should be conducted in circumstances which ensure that the compounds in question are present in a normal, or, in other words, unimolecular, condition.

278. "Liberation of iodine from hydriodic acid by certain halogenated malonyl derivatives." By Martha Annie Whiteley.

During the continuation of the work on derivatives of malonamide (*Proc.*, 1904, **20**, 92) and of barbituric acid (*Trans.*, 1907, **91**, 1330), it has been observed that the mono- and dibromo-derivatives of these series, compounds containing the complex $-CO\cdot CHBr\cdot CO-$ or

$$-CO\cdot CBr_2\cdot CO-,$$

liberate iodine from hydriodic acid at the ordinary temperature according to the equation $>CBr_2 + 4HI = >CH_2 + 2HBr + 2I_2$.

In most cases the reaction is complete, and can be employed as a method for estimating the bromine in the compounds. Quantitative results have been obtained with dibromomalonamide, *bromomalonyldiurethane*, $(CO\cdot NH\cdot CO_2Et)_2CHBr$, m. p. 148°, 5 : 5-dibromo-1 : 3-diphenylbarbituric acid, 5-*bromo*-5-*benzoyl*-1 : 3-*diphenylbarbituric acid*, $C_{23}H_{15}O_4N_2Br$, m. p. 186°, 5-*bromo*-1 : 3-*diphenyl*-2-*thiobarbituric acid*,  $\mathrm{CS}{<}\begin{matrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{matrix}{>}\mathrm{CHBr}$, m. p. 220°, and 5 : 5-*dibromo*-1 : 3-*diphenyl*-2-*thiobarbituric acid*,  $\mathrm{CS}{<}\begin{matrix}\mathrm{NPh\cdot CO}\\ \mathrm{NPh\cdot CO}\end{matrix}{>}\mathrm{CBr_2}$, m. p. 190°; and some of these compounds react also with silver nitrate in the presence of dilute nitric acid, forming silver bromide.

Dichloromalonamide slowly liberates iodine from hydriodic acid at the ordinary temperature, but the reaction is not complete even at 100°.

The replaceability of halogen by hydrogen by the action of hydriodic acid at the ordinary temperature has hitherto been regarded as a characteristic reaction of compounds containing the nitrogen-halogen as distinguished from those containing the carbon-halogen linking (Chattaway, *Trans.*, 1905, **87**, 145; *Chem. News*, 1908, **98**, 285); since the results quoted above show that this generalisation is no longer tenable, it seemed advisable to publish this preliminary statement. The investigation is being extended to other compounds containing the $>CHX$ or $>CX_2$ group to ascertain to what extent the replaceability of the halogen is influenced by the nature of the neighbouring groups.

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THE FOLLOWING PERIODICALS HAVE BEEN PRESENTED TO THE CHEMICAL SOCIETY BY SIR HENRY ENFIELD ROSCOE, D.C.L., LL.D., F.R.S.

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Continued from vol. xi as—

Annalen der Pharmacie. Vereinigte Zeitschrift des neuen Journals der Pharmacie, etc.; des Archivs des Apothekervereins im nördlichen Deutschland; und des Magazins für Pharmacie und Experimentalkritik. Vols. xi—xvi, edited by *J. B.* **Trommsdorff,** *R.* **Brandes,** *P. L.* **Geiger,** and *Justus* **Liebig.** Vols. xvii—xxii, edited by *J. B.* **Trommsdorff,** *J.* **Liebig,** and *E.* **Merck.** Vols. xxiii—xxvi, edited by *J.* **Liebig,** *E.* **Merck,** and *F.* **Mohr.** Vols. xvii—xxxii, edited by *F.* **Wöhler** and *J.* **Liebig.** Heidelberg 1834—39.

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Annalen der Chemie und Pharmacie. Vereinigte Zeitschrift des neuen Journals der Pharmacie, etc.; und des Magazins für Pharmacie und Experimentalkritik. Vols. xxxiii—lxxvi, edited by *F.* **Wöhler** and *J.* **Liebig.** Heidelberg 1840—50. ill.

—— New series. (Vol. i, etc.) Vols. lxxvii—clvii, edited by *F.* **Wöhler,** *J.* **Liebig,** and *H.* **Kopp.** Vols. clviii—clxviii, edited by *F.* **Wöhler,** *J.* **Liebig,** *H.* **Kopp,** *E.* **Erlenmeyer,** and *J.* **Volhard.** Heidelberg 1851—73. ill.

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[*The words* "*und Pharmacie*" *were dropped in* 1874.]

—— Supplement Band. Vols. i—viii. Leipzig 1861—1872.

—— General register.. Vols. i—cclxxvi. 5 vols. Leipzig 1843—1895.

Annales de Chimie et de Physique. 2nd series. By **Gay-Lussac** and **Arago.** [after vol. lxxiii] by **Gay-Lussac, Arago, Chevreul, Savary, Dumas, Pelouze, Boussingault,** and **Regnault.** 75 vols. Paris 1816—40. [Vols. i—iii, reprinted. Paris 1830.]

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—— 7th series. Vol. i—xxi. [*from* vol. ix], by **Berthelot, Friedel, Mascart,** and **Moissan.** 21 vols. Paris 1894—1900.

—— Tables des matières. Series **II**. 3 vols. Paris 1831—1841. Series VI. Paris 1895.

Chemical Society. Memoirs and Proceedings, 1841—1847. 3 vols. London 1841—1848.

—— **The Quarterly Journal of the Chemical Society.** 1848—1861. Vols. i—ii, edited by *E.* **Ronalds.** Vols. iii—xv, edited by *H.* **Watts.** [Vol. xv. *Journal of the Chemical Society.*] 15 vols. London 1849—62.

—— **The Journal of the Chemical Society.** New series. Vol. i, 1863, etc. [Whole series, Vol. xvi, etc.] Vols. xvi—xxxii, edited by *H.* **Watts.** Vols. xxxiii—xlvi, edited by *H.* **Watts** and *C. E.* **Groves.** Vols. xlvii—lxxiv, edited by *C. E.* **Groves** and *A. J.* **Greenaway.** Vols. lxxv—lxxvi, edited by *C. E.* **Groves,** *W. P.* **Wynne,** and *A. J.* **Greenaway.** Vols. lxxvii—lxxxii, edited by *W. P.* **Wynne** and *A. J.* **Greenaway.** Vols. lxxxiii—lxxxviii, edited by *G. T.* **Morgan** and *A. J.* **Greenaway.** Vols. lxxxix—xc, edited by *G. T.* **Morgan,** *J. C.* **Cain,** *A. J.* **Greenaway,** and *C. H.* **Desch.** Vol. xci, etc., edited by *J. C.* **Cain,** *A. J.* **Greenaway,** and *C. H.* **Desch.** London 1863, etc.

Index to Journal. Vols. i—xxv (1848—72), and to the Memoirs and Proceedings (1841—47). Compiled by *H.* **Watts.** London 1874.

A collective index of the Transactions and Abstracts of the Chemical Society, 1873—82. Compiled by *Margaret D.* **Dougal.** London [1899].

—— A collective index of the Transactions, Proceedings, and Abstracts of the Chemical Society, 1833—92. Compiled by *M. D.* **Dougal.** Part I. Index of Authors. Part II. Index of Subjects. 2 vols. London [1898].

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Deutsche chemische Gesellschaft, Berlin. Berichte. Vol. i. 1868, etc. From vol. vi, 1873—82, edited by *H.* **Wichelhaus**; 1883—85, edited by *F.* **Tiemann**; 1886—96, edited by *F.* **Tiemann** and *F. von* **Dechend**; 1897—98, edited by *F.* **Tiemann** and *P.* **Jacobson**; 1898, etc., edited by *P.* **Jacobson.** Berlin 1868 +.

—— General register. 1868—77. Edited by *C.* **Bischoff.** Berlin 1880.

—— General register. 1878—87. By *F.* **Tiemann** and *F. von* **Dechend.** Berlin 1888.

—— General register. 1888—96. 2 vols. By *F. von* **Dechend** and *A.* **Reissert.** Berlin 1898.

At the next Ordinary Meeting on **Thursday,** January **21st,** 1909, at **8.30** p.m., the following papers will be communicated:

"Organic derivatives of silicon. Part IX. Experiments on the resolution of *dl*-benzylethylpropyl*iso*butylsilicane sulphonic acid." By F. S. Kipping and (in part) H. Davies.

"Synthesis of diurea from urea." By F. D. Chattaway.

"Chlorine derivatives of substituted ureas." By F. D. Chattaway and D. F. S. Wünsch.

"Chemical examination of eriodictyon. Part II." By F. Tutin and H. W. B. Clewer.

"The hydration of precipitates." By S. P. U. Pickering.

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SIR ALEXANDER PEDLER, C.I.E., F.R.S.
WILLIAM HENRY PERKIN, PH.D., F.R.S.

TREASURER:

ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

SECRETARIES:

MARTIN ONSLOW FORSTER, D.Sc., PH.D., F.R.S.
ARTHUR WILLIAM CROSSLEY, D.Sc., PH.D., F.R.S.

FOREIGN SECRETARY:

HORACE TABBERER BROWN, LL.D., F.R.S.

OTHER MEMBERS OF COUNCIL:

JULIAN LEVETT BAKER.
GEORGE THOMAS BEILBY, F.R.S.
ALFRED CHASTON CHAPMAN.
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JOHN THEODORE HEWITT, M.A., D.Sc., PH.D.
WILLIAM RICHARD EATON HODGKINSON, PH.D.
HOOPER ALBERT DICKINSON JOWETT, D.Sc.
HENRY RONDEL LE SUEUR, D.Sc.
FRANCIS EDWARD MATTHEWS, PH.D.
ARTHUR GEORGE PERKIN, F.R.S.
WILLIAM JAMES SELL, M.A., Sc.D., F.R.S.
JOHN WADE, D.Sc.

EDITOR OF THE SOCIETY'S JOURNAL:

JOHN CANNELL CAIN, D.Sc.

SUB-EDITOR OF THE SOCIETY'S JOURNAL:

ALFRED JOHN GREENAWAY.

ASSISTANT SUB-EDITOR:

CECIL HENRY DESCH, D.Sc., PH.D.

ASSISTANT SECRETARY:

STANLEY ERNEST CARR.

LIBRARIAN:

FRANCIS WILLIAM CLIFFORD.

COMMITTEES, 1908–9.

Sir William Ramsay (President), Dr. A. Scott (Treasurer), Dr. M. O. Forster and Prof. A. W. Crossley (Hon. Secretaries), and Dr. Horace T. Brown (Foreign Secretary), are *ex officio* members of each Committee.

FINANCE COMMITTEE.

Messrs. E. G. Hooper, G. T. Moody, T. E. Thorpe, W. A. Tilden, and the Officers.

HOUSE COMMITTEE.

Messrs. W. R. Dunstan, J. E. Reynolds, W. J. Russell, J. Millar Thomson, T. E. Thorpe, W. A. Tilden, and the Officers.

LIBRARY COMMITTEE.

Messrs. E. C. C. Baly, B. H. Brough, F. D. Chattaway, B. Dyer, A. Harden, C. A. Keane, A. Lapworth, E. J. Mills, J. Millar Thomson (Chairman), J. A. Voelcker, J. Wade, the Editor, and the Officers.

PUBLICATION COMMITTEE.

Messrs. E. C. C. Baly, W. R. Dunstan, J. T. Hewitt, R. Meldola, G. T. Morgan, T. E. Thorpe, J. Wade, and the Officers.

RESEARCH FUND COMMITTEE.

Messrs. G. T. Beilby, P. F. Frankland, A. D. Hall, G. Matthey, R. Meldola, R. Messel, Sir A. Pedler, W. H. Perkin, J. E. Reynolds, W. A. Tilden, and the Officers.

The Ordinary Scientific Meetings for 1908-9 will be held on the following Thursdays at 8.30 p.m. :—

October 22nd, 1908
November 5th, ,,
,, 19th, ,,
December 3rd, ,,
,, 17th, ,,
January 21st, 1909
February 4th, ,,
,, 18th, ,,

March 4th, 1909
,, 18th, ,,
April 1st, ,,
May 6th, ,,
,, 20th, ,,
June 3rd, ,,
,, 17th, ,,

Annual General Meeting, Thursday, March 25th, 1909, at 4 p.m.

Society's Bankers:

Messrs. COUTTS & CO., 440, Strand, W.C.

Telephone No.: 1368, Mayfair.

THE CHEMICAL SOCIETY.

The Chemical Society was founded on February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice thereof from the Secretaries.

Each Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications so long as his Annual Subscription be not in arrear. He is also entitled to the use of the books in the Society's Library, under such restrictions as the Council may deem necessary. He has the privilege of introducing to Ordinary Scientific Meetings of the Society, two visitors, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

When elected, every Candidate previous to admission is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due

on the first day of January of every year. The life composition fee is £30, excepting that Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If a Candidate be elected during the month of November or December, he will not be called upon to pay any annual subscription for the current year, and will not be entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March owes two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, shall cease to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have decided that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. Papers which, on the report of referees, are deemed by the Council unsuitable for publication in the Transactions, are deposited in the Society's Archives. In all cases, an abstract of the paper, not exceeding three hundred words in length, should be supplied for insertion in the Proceedings.

Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

PUBLICATIONS OF THE SOCIETY.

With the exception of certain numbers of the Journals and Proceedings which are out of print, the following publications may be obtained from Messrs. Gurney and Jackson, 10, Paternoster Row, E.C. :

		Price to Fellows.			Price to Public.		
		£	s.	d.	£	s.	d.
Memoirs and Proceedings, 1841–1847 (3 Vols.) ...	per vol.	1	0	0	1	10	0
Quarterly Journal, 1848–1862 (14 Vols.)...	per vol.	1	0	0	1	10	0
,, ,, ,, ,, (Single Parts)	per part		5	0		7	6
Journal, 1862–1895	per vol.	1	10	0	1	10	0
,, ,, ,, (Single Parts)	per part		2	6		2	6
,, 1896 to present date	per vol.	2	0	0	2	0	0
,, ,, ,, (Single Parts)	per part		3	6		3	6
Proceedings, 1885 to present date	per vol.		7	6		7	6
,, ,, ,, (Single Parts) ...	per part			6			6
Annual Reports on the Progress of Chemistry (bound in cloth), Vols. I (1904), II (1905), III (1906), IV (1907)	per vol.		4	6		4	6
Collective Index, Vol. I. 1841–1872	per vol.		4	0		4	0
* ,, ,, ,, II. 1873–1882	per vol.		10	0		15	0
* ,, ,, ,, III. 1883–1892	per vol.		15	0	1	0	0
* ,, ,, ,, IV. 1893–1902	per vol.	1	0	0	1	10	0
†Jubilee Volume, 1891...			6	0		6	0
†Memorial Lectures, 1893–1900			7	6		7	6
†Library Catalogue, 1886			1	0		1	0
† ,, ,, 1903			2	6		2	6
†Cases for binding the Journal in 4 vols....	per year		4	0		4	0
Tables of International Atomic Weights (as recommended by the International Atomic Weights Committee). 1/6 per doz. ; 12/- per hundred.							

* Postage to Fellows One Shilling extra.
† Post free to Fellows.

The *Journal*, which is published on the last day of each month, includes the Transactions of the Chemical Society and Abstracts of chemical papers published in other Journals.

The *Proceedings* contain certain papers read at the meetings and abstracts of the remainder and of the discussions. They are, as a rule, issued to the Fellows about a week after each Ordinary Scientific Meeting.

The Annual Reports on the Progress of Chemistry contain an epitome of the principal definite steps in advance which have been made during the year. Fellows can obtain, from the Assistant Secretary, cases for binding the Annual Reports, price One Shilling each.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. In future the income accruing from the munificent donations received from the Goldsmiths' Company and from the Perkin Memorial Fund will be devoted as far as possible to the encouragement of research in (*a*) metallurgical and inorganic chemistry and (*b*) the chemistry of coal-tar products, respectively.

The Committee meets twice a year to consider applications for grants; and forms of application, which can be obtained from the Assistant Secretary, must be lodged with the Secretaries before the end of May and November in each year.

NAMES OF HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. Svant August, Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. Stanislao, F.R.S., Reale Università, Rome
May 18, 1904	Clarke, Prof. Frank Wigglesworth, LL.D. (Aberd.), United States Geological Survey, Washington, D.C., U.S.A.
May 18, 1904	Curie, Madame Marie, La Sorbonne, Paris
Jan. 20, 1898	Curtius, Geh. Rath Prof. Dr. Theodor, Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. Emil, Aschaffenburg, Germany
June 16, 1892	†Fischer, Geh. Rath Prof. Dr. Emil, F.R.S., Hessischestrasse 1, Berlin, N, Germany
Feb. 1, 1883	Fittig, Prof. Dr. Rudolph, Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. Antoine Paul Nicolas, Rapenburg 104, Leyden
Feb. 6, 1908	Gautier, Prof. Armand Emile Justin, 9, Place-des-Vosges, Paris
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Westendstrasse 28, Frankfurt-am-Main, Germany
Feb. 6, 1908	Haller, Prof. Albin, 10, Rue-Vauquelin, Paris
Feb. 6, 1908	Hittorf, Dr. Johann Wilhelm, Westfälische Wilhelms-Universität, Münster, Westfalen, Prussia
Feb. 2, 1888	Hoff, Prof. Dr. Jacobus Henricus van't, F.R.S., Lietzenburgerstrasse 54, Berlin, 15, W., Germany
Jan. 20, 1898	Körner, Prof. Wilhelm, R. Scuola superiore d'Agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath Prof. Dr. Albert, Kaiser Wilhelmstrasse 108, Breslau
Feb. 2, 1888	Landolt, Geh. Rath Prof. Dr. Hans, Kaiserallee 222, Berlin, W.
Feb. 6, 1908	Le Bel, Joseph Achille, 250, Rue Saint Jacques, Paris
Feb. 6, 1908	Le Chatelier, Prof. Henri Louis, 73, Rue Notre Dame des Champs, Paris
June 16, 1892	Lieben, Prof. Dr. Adolph, Mölkerbastei 5, Vienna I., Austria
May 18, 1904	Liebermann, Geh. Rath Prof. Dr. Carl, Matthäikirchstrasse 29, Berlin, W., Germany
May 18, 1904	Morley, Prof. Edward Williams, West Hartford, Conn., U.S.A.

* Faraday Lecturer, 1872.
† Faraday Lecturer, 1907.

Date of Election.	
Jan. 20, 1898	*Ostwald, Geh. Rath Prof. Dr. Wilhelm, LL.D.(Aberd.), Grossbothen, Kgr., Sachsen
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.
Feb. 6, 1908	Richards, Prof. Theodore William, A.B. and Ph.D. (Harvard), Harvard University, Cambridge, Mass., U.S.A.
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence, Italy
June 16, 1892	Schlœsing, Prof. Dr. Théophile, Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. Walthère, Rue Beckmann 32, Liége, Belgium
May 18, 1876	Thomsen, Prof. Dr. Julius, F.R.S., Lindevei 13, Copenhagen
Jan. 20, 1898	Troost, Prof. Louis Joseph, Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. Johannes Diderik van der, T.C., Hooftstraat 117 Amsterdam
Feb. 6, 1908	Wallach, Prof. Dr. Otto, Königl. Georg August Universität, Göttingen, Prussia.

* Faraday Lecturer, 1904.

FARADAY LECTURERS.

1869.	Jean Baptiste André Dumas.
1872.	Stanislao Cannizzaro.
1875.	August Wilhelm von Hofmann.
1879.	Charles Adolphe Wurtz.
1881.	Hermann Ludwig Ferdinand von Helmholtz.
1889.	Dmitri Ivanovitsch Mendeléeff.
1895.	Lord Rayleigh.
1904.	Wilhelm Ostwald.
1907.	Emil Fischer.

LONGSTAFF MEDALLISTS.

1881.	Thomas Edward Thorpe.
1884.	Cornelius O'Sullivan.
1888.	William Henry Perkin.
1891.	Francis Robert Japp.
1894.	Horace Tabberer Brown.
1897.	William Ramsay.
1900.	William Henry Perkin, jun.
1903.	William Jackson Pope.
1906.	Walter Noel Hartley.

In order that the List of Fellows may be as complete as possible, those Fellows whose names and degrees do not appear in full are requested to communicate with the Assistant Secretary. Inaccuracies should be reported without delay.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society ; V.P. as Vice-President ;
S. as Secretary ; T. as Treasurer ; F.S. as Foreign Secretary ; P. as President.

Date of Election.			
1906			Abegg, Richard, Prof., Ph.D. (Berlin), Landsbergstrasse 4, Breslau, Germany
1903	Trans.		Abell, Robert Duncombe, D.Sc. (Wales), Ph.D. (Leipzig), F.I.C., University College of South Wales and Monmouthshire, Cardiff
1871	Trans.	C. 1882-4	Abney, Sir William de Wiveleslie, K.C.B., Hon. D.C.L. (Dun.), Hon. D.Sc. (Vict.), Sc.D. (Dub.), F.R.S., F.I.C., Rathmore Lodge, Bolton-gardens-south, S.W.
1883			Abraham, Alfred Clay, F.I.C., 87, Bold-street, Liverpool
1890			‖Abrines, Gustavus Anthony, Sanitary Commissioner's Office, Gibraltar
1875	Trans.		Acworth, Joseph John, Ph.D. (Erlangen), F.I.C., Thornbank, Shootup-hill, Brondesbury, N.W.
1905			Adam, Adam Lawson Kelly, 296, Bath-street, Glasgow
1892			Adams, Arthur, F.I.C., Kelvin House, Edgbaston-road, Smethwick
1877	Trans.		‖Adams, Matthew Algernon, F.R.C.S. (Eng.), F.I.C., The Kulm, Bearsted, near Maidstone
1901			Adams, Ormsby Gore, School of Mines, Thames, Auckland, New Zealand
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helens, Lancs.
1896			Addie, Robert, Messrs. Kennedy and Addie, Norfolk House, Laurence Pountney Hill, E.C.
1881	Trans.		Adeney, Walter Ernest, Hon. D.Sc. (R.U.I.), A.R.C.S.I., F.I.C., Royal University of Ireland, Earlsfort-terrace, Dublin
1885	Trans.		Adie, Richard Haliburton, M.A. (Cantab.), B.Sc. (Lond.), 136, Huntingdon-road, Cambridge
1885			Adriance, John Sabine, Ph.D., The Union League Club, New York City, U.S.A.
1906			Agar, Shelton Gottlieb, La Fontaine, Clifton, Guernsey, Channel Islands

Date of Election.		
1905	Trans.	Ahlum, Charles Chester, c/o Messrs. G. W. Lord and Co., Philadelphia, Pa., U.S.A.
1879		Albright, George Stacey, M.A. (Cantab.), Bromesberrow-place, Ledbury
1893		Albuquerque, John Pedrozo d', Prof., M.A. (Cantab.), F.I.C., Government Laboratory, Barbados, West Indies
1885		Alcock, Frank Harris, F.I.C., 9, Broad-street Corner, Birmingham
1892		Alcock, John While, Central Brewery, 45, Mott-street, Birmingham
1902		Alder, John Frederick, 28, Claverly-grove, Church-end, Finchley, N.
1903		Alderton, Gilbert John, B.Sc. (Lond.), F.I.C., The Nest, Eglinton-road, Plumstead, Kent
1888	Proc.	Alexander, John, M.A. (Glas.), Midfield, Perth
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, 55, Northern-grove, West Didsbury, near Manchester
1907		Allan, John Campbell, 91, Norse-road, Scotstoun, Glasgow
1907		Allen, Alfred Frederick, B.Sc. (Lond.), 35, Purrett-road, Plumstead, S.E.
1894		Allen, Frederick John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, Frederick Thomas, B.Sc. (Dun.), 32, Currock-terrace, Carlisle
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1904		Allen, William Harold Richard, c/o Straits Trading Co., Butterworth, Penang, Straits Settlements
1894		Allibon, George Henry, Mayfield, Lisburn-road, Balmoral, Belfast
1905		Allison, James Albert, Luchana Laboratory, Apartado 45, Bilbao, Spain
1908	Trans.	Allmand, Arthur John, M.Sc. (L'pool), 65, Fulwood-road, Liverpool
1899		Allworthy, James Herbert, Emanuel School, Wandsworth Common, S.W.
1899		‖Allworthy, Samuel William, M.A., M.D., B.Ch., L.M. and D.P.H. (Dub.), The Manor House, Antrim-road, Belfast
1903		Alton, William Lester St. John, F.I.C., 11, Briar-walk, Putney, S.W.
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. (Oxon.), 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc. (Lond.), F.I.C., 31a, Clanricarde-gardens, W.
1895		Anderson, Herbert, Royal Latin School, Buckingham
1899		Anderson, James William, The Paddock, Halling, near Rochester

Date of Election.			
1906			Anderson, Robert, Chester-road-west, Sunderland
1901	Trans.		Anderson, William Carrick, M.A., D.Sc. (Glas.), 7, Scott-street, Garnethill, Glasgow
1892			Anderson, William Smellie, Christmas Island, Straits Settlements
1908			Andreae, Edward Philip, Ph.D. (Berlin), Crestalba, Champion Hill, S.E.
1905	Trans.		Andrews, Albert Edward, St. Hilda, 20, Carew-road, Thornton Heath, Surrey
1888			Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882			‖Andrews, Launcelot Winchester, Ph.D. (Göttingen), 3731, Westminster-place, St. Louis, Mo., U.S.A.
1905	Trans.		Angel, Andrea, M.A. and B.Sc. (Oxon.), 17, Banbury-road, Oxford
1877			Angell, John, F.I.C., 6, Beacon's-field, Derby-road, Withington, Manchester
1898	Trans.		Annable, Henry William Coupe-, Gresham House, Egham, Surrey
1905			Anthony, Charles, jun., M.Inst. C.E., Casilla de Correo, 149, Bahia Blanca, Argentine, S. America
1879			‖Appleby, Herbert, 2, John Dalton-street, Manchester
1903			Appleyard, George Henry, F.I.C., Wilmington Oil Mills, 151, Cleveland-street, Hull
1890	Trans.		Appleyard, James Robert, Royal Technical Institute, Salford
1903			‖Appleyard, Percy, Albany, Western Australia
1884			Archbutt, Leonard, F.I.C., The Yews, Madeley-street, Derby
1875			Armistead, William, M.B. and C.M. (Edin.), Stapleford, Cambridge
1900	Proc.		Armitage, Francis Paul, 13, Palliser-road, West Kensington, W.
1903	Trans.		‖Armstrong, Edward Frankland, D.Sc. (Lond.), Ph.D. (Berlin), c/o Messrs. Huntley & Palmers, Reading
1899			Armstrong, Frederick William, 6, St. Thomas's-terrace, Wells, Somerset
1870	Trans.	C.1873-5 S. 1875-93 P.1893-5	‖Armstrong, Henry Edward, Prof., LL.D. (St. Andrews), Ph.D. (Lips.), F.R.S., 55, Granville-park, Lewisham, S.E.; and Central Technical College, Exhibition-road, S.W.
1905			Arnaud, Francis William Frederick, F.I.C., The Town Hall, Portsmouth
1906	Trans.		Arup, Paul Seidelin, M.A. (Nova Scotia), 62, Haverstock Hill, N.W.
1894			Ashdown, Charles Henry, Monastery-close, St. Albans
1903			Ashdown, Herbert Henry, 88, Southgrove-road, Sheffield
1900			Ashton, James, Hacken Sewage Works, Moses-gate, Bolton
1905			Ashwell, James Henry, 117, Waterloo-crescent, Nottingham
1901			Aspinall, Thomas, 62, Gilnow-road, Bolton

Date of Election.			
1900	Trans.		Aston, Bernard Cracroft, N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, William George, 12, Douglas-road, Goodmayes, Ilford, E.
1903			Atkinson, Harford Montgomery, B.Sc. (Wales), Ph.D. (Göttingen), 69, George-street, Limerick, Ireland
1872	Trans.		‖Atkinson, Robert William, B.Sc. (Lond.), F.I.C., 44, Stuart-street, Cardiff
1862	Trans.	C. 1874-8	‖Attfield, John, Prof., M.A. and Ph.D. (Tübingen), F.R.S., F.I.C., Ashlands, Watford, Herts.
1903	Trans.		Attwell, Herbert Moore, A.R.C.S., Stoke Hill House, Limpley Stoke, Bath
1872	Trans.		‖Attwood, George, M.Inst.C.E., Steyning Manor, Stogursey, Somerset; and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1903			Aubrey, Henry James, The Cross, Worcester
1895	Trans.		‖Auden, Harold Allden, Central Laboratory, United Alkali Co., Widnes, Lancs.
1886			Audley, James Aloysius, B.Sc. (Lond.), A.R.C.S., F.I.C., c/o Messrs. G. Howson and Sons, Eastwood Sanitary Works, Hanley, Staffs.
1906	Trans.		‖Austin, Percy Corlett, M.A. (Cantab.), Bingham, near Nottingham
1892			Avery, David, Working Men's College, Melbourne, Australia
1896			Aykroyd, Henry Edward, Scaitcliffe, Queen's-road, Ilkley, Yorks.
1891			Aylan, John Charles, Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1903			‖Badcock, William Cornish, M.A. (Cantab.), The Grammar School, Crediton, Devon
1907	Trans.		Bagley, George, c/o Young's Chemical Works, 41B, Kent-terrace, Wellington, New Zealand
1904			Baguley, Allan, B.Sc. (Wales), F.I.C., Harris Institute, Preston
1907			Bailey, Francis James, Findon Hill, Sacriston, Durham
1875	Trans.		‖Bailey, George Herbert, Ph.D. (Heidelberg), D.Sc. (Lond.), The University, Manchester; and Marple Cottage, Marple, Cheshire
1893			Bailey, Henry, 6, Melrose-avenue, Wimbledon Park, S.W.
1900	Trans.		Bain, Alexander William, B.A., B.Sc. (Lond.), F.I.C., Fairlight, Muswell-rise, Muswell Hill, N.
1884			‖Bain, Daniel, United Alkali Co., Ltd., Allhusen's Works, Gateshead-on-Tyne
1891			Bairstow, John, Burley, Queen's-park, Chester
1901			Baker, Arthur, 2, Carlton-avenue, Horn's Cross, Greenhithe, S.O., Kent
1889			‖Baker, Charles Frederic, B.Sc. (Lond.), Ph.D. (Strassburg), Technical College, Sunderland

Date of Election.			
1883	Trans.		‖Baker, Charles John, The Schools, Shrewsbury
1899			Baker, Clement Harrison, c/o Messrs. C. Harrold & Co., 2 and 3, St. Paul's-square, Birmingham
1907	Trans.		Baker, Frank, B.Sc. (Lond.), A.I.C., St. John's School, Eton; and 50, Frederick-street, Widnes
1902			Baker, Frederick Guy Stirling, M.A. (Oxon.), Marryatt's Lodge, Snaresbrook, Essex
1900			Baker, Frederick Nolan, Lieut., R.A., c/o Messrs. W. T. Allen & Co., 132, Queen Victoria-street, E.C.
1881	Trans.		Baker, Harry, F.I.C., Epworth House, Moughland-lane, Runcorn, Cheshire
1884	Trans.	C. 1899-03	‖Baker, Herbert Brereton, M.A., D.Sc. (Oxon.), F.R.S., Christ Church, Oxford
1893	Trans.	C. 1908-	Baker, Julian Levett, F.I.C., Stainesbury Holt, Kingston-road, Staines
1901			Baker, Thomas Thorne, 7, St. James'-avenue, Cricklewood, N.W.
1908			Baker, William Henry Benson, B.A. (Oxon.), Frognal Dene, Hampstead, N.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon
1901	Trans.		Ball, Walter Craven, B.A. (Oxon.), Guy's Hospital, S.E.; and 2, Keston-villas, Keston, Kent
1907			Ball, William Robert, B.Sc. (Lond.), 48, Cambridge-road, Thornaby-on-Tees
1892			‖Ballantyne, Horatio, F.I.C., 75, Chancery-lane, W.C.
1908			Ballantyne, William Henry, B.Sc. (Glas.), 99, Holmdene-avenue, Herne Hill, S.E.
1896			Ballingall, William, M.A. (St. Andrews), Ardarrock, Dundee
1891	Trans.	C. 1905-08	Baly, Edward Charles Cyril, F.I.C., University College, Gower-street, W.C.
1886			Bamber, Henry Kelway George, Ingress House, Greenhithe, Kent
1890	Proc.		Bamber, Montague Kelway, F.I.C., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1896			Banerjee, Gopal Chandra, Kaiser Soap Co., Cawnpore, India
1907			Banks, Arthur John, c/o Graflik Lubricant Co., 1, Rowland-street, Miles-street, Liverpool
1906			Banner, George Ernest, 10, Highfield-road, Rock Ferry, Cheshire
1871			‖Bannister, Richard, F.I.C., 59, Tregunter-road, S. Kensington, S.W.
1904	Trans.		Barbour, William, M.A. and B.Sc. (St. Andrews), F.I.C., Dalswinton, 26, All Saints'-road, Peterborough
1905			Barbrook, George Henry, c/o Messrs. T. Prentice & Co., Stowmarket, Suffolk
1880			‖Barclay, Arthur Edward, 95, Farringdon-street, E.C.

Date of Election			
1903	Trans.		‖Barger, George, M.A. (Cantab.), D.Sc. (Lond.), The Wellcom Physiological Research Laboratories, Brockwell Hall, Hern Hill, S.E.
1906			Barker, Arthur Ernest, B.A., B.Sc. (Lond.), Royal Gramma School, Colchester
1890			‖Barker, Joseph, Rev., M.A. and D.D. (Oxon.), Newton House Newton, near Nottingham
1903	Trans.		Barker, Thomas Vipond, B.A. and B.Sc. (Oxon.), Mineralogica Dept., University Museum, Oxford
1896			Barker, William Henry, B.Sc. (Lond.), Addiscombe, Empress avenue, Wanstead Park, Essex
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1894			Barlet, Stéphane, B. ès Sc. (Gall.), 97, St. Mark's-road, North Kensington, W.
1897			Barlow, Herbert William Leyland, M.A. and M.D. (Oxon.) M.R.C.S. and L.R.C.P. (Lond.), D.P.H., (Cantab.), Holl Bank, Croftsbank-road, Urmston, Manchester
1897	Trans.		Barlow, William, F.R.S., The Red House, Stanmore, Middlesex
1891			Barnes, Edward Arthur, c/o Nordenfjeldske Sproengstof Aktieselskab, Aasenfjorden, Norway
1905			Barnes, James Hector, Prof., B.Sc. (Birm.), F.I.C., Government College of Agriculture, Lyallpur, Punjab, India
1875			‖Barnes, Richard Leburn, Phœnix Chemical Works, Hackne Wick, N.E.
1907	Proc.		Barnett, Edward de Barry, University College, Gower-street, W.C
1908			Barr, Guy, B.A. (Cantab.) B.Sc. (Lond.), 79, Fillebrook-road Leytonstone, N.E.
1888			‖Barraclough, William Herbert, F.I.C., Mortomley, near Sheffiel
1891			Barratt, John Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward Louis, B.Sc. (Lond.), F.I.C., 12, Avenue de l Grande Armée, Paris
1906	Trans.		Barrett, Ernest, B.Sc. (Lond.), 121, Algernon-road, Lewisham S.E.
1901			Barrie, Thomas Stewart, 4, Newton-street, Charing-cross Glasgow
1905	Trans.		Barrowcliff, Marmaduke, F.I.C., 82, Highfield-road, Dartford Kent
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1908			Barton, Robert, jun., 48, Wellclose-mount, Carlton-hill, Leeds.
1898			Baskerville, Charles, B.Sc. (Virginia), Ph.D. (N. Carolina) College of the City of New York, New York City, U.S.A.
1864	Trans.	{C. 1870-8, 90-8}	‖Bassett, Henry, F.I.C., 26, Belitha-villas, Barnsbury, N.
1907	Trans.		Bassett, Henry, jun., D.Sc. (Lond.), Ph.D. (Munich), D. ès Sc (Nancy), F.I.C., The University, Liverpool

Date of Election.			
1891			Bate, William, Ladbroke, Hayle, Cornwall
1893			Bateman, John, Clovelly, 14, Stirling-road, Clapham Rise, S.W.
1896			Bathurst, Charles, jun., B.A. (Oxon.), 3, Stone-buildings, Lincoln's Inn, W.C.
1905			Baxter, John George, River View, Burch-road, Rosherville
1896			Bay, Lauritz Hansen, B.Sc. (Lond.), Deacon's School, Peterborough
1892			Bayliss, Charles, Mino, Castle Bromwich, near Birmingham
1906			Bayliss, William Heath, Brewery House, Ashwell, Herts.
1874			Bayly, Francis William, Church Cobham, Cobham, Surrey
1903			Bayly, Harold Goodenough, F.I.C., Usine St. Madeleine, Trinidad, West Indies
1874			‖Bayne, James, 31, Vaughan-terrace, Harrow
1879			‖Bayne, William Thirlwall, LL.D. (Cantab.), Brockhill, Broadclyst, Exeter
1897			Beadle, Alec Alfred, 333, Gray's Inn-road, W.C.
1891	Trans.		Beadle, Clayton, Halewood, Sidcup, S.O., Kent
1861			‖Beadnell, Charles Edward, Major, R.A., Hafod, Llandinam, S.O., Montgomeryshire
1903			Beadnell, Charles Marsh, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Fleet Surgeon, H.M.S. King Alfred, China Station
1867			Beale, William Phipson, K.C., M.P., 10, New-court, Carey-street, Lincoln's Inn, W.C. ; and 2, Whitehall-court, S.W.
1905			Bealey, Edward Williams, B.A. (Cantab.), 14, Kildare-gardens, Bayswater, W.
1903			Beam, William, M.A., M.D. (Penn.), F.I.C., Chemical Laboratory, Gordon College, Khartoum, Soudan
1899			Bean, Percy, 17, Dickinson-street, Manchester
1902			Beanes, Alfred Edward, Falcon Works, Wallis-road, Hackney Wick, N.E.
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, George Russell, L.R.C.P. (Lond.), M.R.C.S. (Eng.), L.S.A., D.P.H. (Cantab.), Warwick House, Upper-street, Islington, N.
1901			Beaven, Edwin Sloper, 5, Boreham-terrace, Warminster
1890	Trans.		Beck, Charles Ridgeway, F.I.C., 33, Werter-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, F.I.C., 35, South Beach-road, Ardrossan, N.B.
1906			Beckett, Richard Henry, Prof., B.Sc. (Lond.), The College, Nagpur, C.P., India
1901			Bedford, Frederick, B.Sc. (Lond.), Ph.D. (Halle), 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, Peter Phillips, Prof., M.A., D.Sc. (Lond. and Dun.), B.Sc. (Vict.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne

Date of Election			
1901			Bedwell, John Cardew, B.Sc. (Lond.), 65, High-street, Colchester
1905			Bees, William James, B.Sc. (Lond.), 43, Ash-grove, Hyde-park, Leeds
1899			Beesley, Frederick Arnold, B.Sc. (Lond.), 23, Whitmore-road, Beckenham, Kent
1872	Trans.	C. 1907-	‖Beilby, George Thomas, F.R.S., F.I.C., 11, University-gardens, Glasgow
1891			Belbin, Tom St. John, Capt., Nortonthorpe Hall, near Huddersfield
1888			Belcher, John Hope, B.A., B.Sc. (Lond.), Municipal Technical Institute, Coventry
1891			‖Bell, Albert Edward, F.I.C., 59, Trinity-square, Southwark, S.E.
1886	Trans.		Bell, Chichester Alexander, B.A., M.B. (Dub.), F.I.C., Brooklands, Dawlish, S. Devon
1889			Bell, Edward Wightman, The Chantry, Spalding
1898			Bell, Hugh Poynter, M.A. (Cantab.), 17, Tothill-street, Westminster, S.W.
1865	Trans.		‖Bell, J. Carter, A.R.S.M., F.I.C., The Cliff, Higher Broughton, Manchester
1907			Bell, John Forbes, Craigmillar, Edinburgh
1889			‖Bell, Percy Carter, F.I.C., Milburn, New Jersey, U.S.A.
1906			Bell, William Edward, Langholm, Yarborough-road, Lincoln
1904	Trans.		Bellars, Albert Ernest, B.A. (Cantab.), Magdalene College, Cambridge
1905			Belton, Francis George, 16, Clarkson-street, Glossop-road, Sheffiel
1879			Bemrose, Joseph, F.I.C., 56, St. Famille-street, Montreal, Canad
1874			‖Bendix, David, F.I.C., Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1902	Proc.		Bengough, Guy Dunstan, M.A. (Cantab.), The University, an 25, Huskisson-street, Liverpool
1902			Benham, Keith Benham, B.Sc. (Lond.), F.I.C., Dean's Hill Stafford
1881			‖Benjamin, Marcus, A.M. (Lafayette), Ph.B. (Columbia), Ph.D (Nashville), Sc.D. (Pennsylvania), U.S. National Museum Washington, D.C., U.S.A.
1904			Benn, Robert Haslam Durward, West Mount, Montreal, Canada
1900	Trans.		Bennett, Alexander Hutcheon, c/o Messrs. Ogston & Moor Messina, Sicily
1904			Bennett, Charles Thomas, B.Sc. (Lond.), A.I.C., 57, Larkhall rise, Clapham, S.W.
1903			Bennett, Colin Noël, Escot, Penzance, Cornwall
1905			Bennett, Joseph, Windsor Printing Co., North Adams, Mass. U.S.A.

Date of Election.			
1892	Trans.		Bensusan, Arthur John, The Ouro Preto Gold Mines of Brazil, Ltd., Minas de Passagem, Ouro Preto, Brazil
1904			Bentley, Walter Henry, M.A. (Oxon.), Merton, Everton-road, Addiscombe, Croydon
1896	Trans.		Bentley, William Henry, B.Sc. (Vict.), 12, Cromwell-terrace, Irlam, near Manchester
1907			Benton, Frank Stanley, Hursthead, Reigate, Surrey
1890			Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1902	Trans.		Bergtheil, Cyril, Research Station, Sirseah, Mozufferpore Post Office, T. S. Railway, India
1882			‖Beringer, John Jacob, A.R.S.M., F.I.C., Basset-road, Camborne, Cornwall
1895	Trans.		Berkeley, The Rt. Hon. The Earl of, F.R.S., Foxcombe, Boar's Hill, Oxford
1890			‖Berncastle, Richard, 15, Ladbroke-gardens, Notting Hill Gate, W.
1893			Berridge, Douglas Jesse Penfold, M.A. (Oxon.), The Laboratory, Malvern College
1906			‖Berry, Arthur John, 5, University-gardens, Glasgow
1882			‖Berry, Edward Elhanan, F.I.C., 44, London Wall, E.C.
1907			Berry, Leslie Hamilton, B.Sc. (Lond.), A.I.C., Penshurst, Croham Park-avenue, S. Croydon
1898			Berry, Reginald Arthur, F.I.C., The West of Scotland Agricultural College, 6, Blythswood-square, Glasgow
1891			Berry, Thomas William, Education Office, Pentre, Rhondda, Glam.
1888	Proc.		Berry, William, 7, Hampton-park, Redland, Bristol
1906			Bethea, Oscar Walter, Prof., M.D. (Miss.), Ph.G. (Atlanta), Mississippi Medical College, Meridian, Miss., U.S.A.
1883	Trans.	{C. 1898-1900}	‖Bevan, Edward John, F.I.C., 3, New-court, Carey-street, W.C.
1908			Bevan, Edward Morris, 10, Coronation-street, Aberkenfig, near Bridgend
1886			Bevan, John Williams, F.I.C., Risedale, St. James-crescent, Swansea
1903			Beveridge, Wilfred William Ogilvy, Major, R.A.M.C., D.S.O., M.B. (Edin.), D.P.H. (Cantab.), R. Army Clothing Dept., Grosvenor-road, S.W.
1897			Bhaduri, Jyoti Bhushan, M.A. (Calcutta), Krishnaghur College, Krishnaghur, Dist. Nadia, Bengal, India
1903			Bhaduri, K., Prof., M.A. (Calcutta), Canning College, Lucknow, India
1903			Bibby, Charles Drake, 69, Queen's-road, Twickenham, Middlesex
1903			Bibby, Robert Gordon, York Hotel, Albemarle-street, W.
1865			‖Bickerdike, William Edward, F.I.C., Bryers Croft, Wilpshire, near Blackburn
1901			‖Bickford, Harding, 46, Currie-street, Adelaide, South Australia

Date of Election			
1875			Biggart, John William, F.I.C., Chemical Laboratory, 29, Cathcart-street, Greenock
1872			Biggs, Charles Henry Walker-, 140, Salisbury-court, Fleet-street, E.C.
1881			Bingley, John, Northampton
1900			Binks, Frederick Nisbet, 39, Kenilworth-road, Monkseaton, Northumberland
1894			Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898			Birkett, Walter, 23, Carline-road, Lincoln
1906			Birt, Roderick Harold Capper, B.A. (Oxon.), St. Peter's College, Radley, Abingdon
1879			‖Black, Andrew Heggie, St. John's, Wakefield; and Moor Lodge, Harrogate
1904			Black, John Wyclif, 20, Mardale-crescent, Edinburgh
1886			Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1899	Trans.		Blackman, Walter Lionel, Stanthorpe-road, Streatham, S.W.
1903			Blackshaw, George Neville, B.Sc. (Wales), Government School o Agriculture, Elsenburg, Mulder's Vlei, Cape Colony, S. Africa
1899			Blackshaw, John Frank, The Midland Dairy Institute, Kingston Fields, Derby
1902			Blair, Herbert, 23, Ashley-road, West Harton, South Shields
1901			Blake, George Stanford, 10, Pyrland-road, Richmond, Surrey
1890	Trans.		Blake, Robert Frederick, F.I.C., Chemical Department, Queen' College, Belfast
1890			Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne
1875			‖Blanshard, Charles Thomas, M.A. (Oxon.), Enfield-mount, Woolton, Liverpool
1906			Blatchley, Charles Frederick Polwhele, B.A. (Oxon.), 56, St John's Wood-terrace, N.W.
1892			Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1902			Blenkinsop, Richard, c/o Messrs. May & Baker, Ltd., Garde Wharf, Church-road, Battersea, S.W.
1890			Blenkinsop, William Edmund Brandford, c/o Messrs. May an Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1903			Bliss, Henry James Wheeler, M.A. (Oxon.), c/o The Thame Varnish Co., Ltd., Island Wharf, Rainham, Essex
1899			Blofeld, Stuart, Rev., B.A., B.Sc. (Lond.), St. John's College Battersea, S.W.
1896			‖Blood, Maurice, M.A. (Oxon.), 16, Alexandra-road, Kingston-on Thames
1891			Bloomer, Frederick John, F.I.C., Penpont, Clydach, S.O. Glamorgan

Date of Election		
1890	Trans.	Blount, Bertram, F.I.C., 76 and 78, York-street, Westminster, S.W.
1888		Bloxam, Arthur George, F.I.C., 105, Birkbeck Bank-chambers, Southampton-buildings, W.C.
1883	Trans.	‖Bloxam, William Popplewell, Prof., B.Sc. (Lond.), F.I.C., Clothworkers Research Laboratory, The University, Leeds
1903		Bluman, Nicholas John, c/o Messrs. Bluman & Stern, Ltd., Plough-bridge, Deptford, S.E.
1887		Blundstone, Edwin Richardson, B.A (Cantab.), Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, Thomas Porter, M.A. (Oxon.), F.I.C., Tower-place, Shrewsbury
1896		Blyde, Joseph Edwin Alger, Merlin House, Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S. (Eng.), L.S.A. (Lond.), F.I.C., 26, Avenue-road, Regent's Park, N.W.
1892		Blyth, Meredith Wynter, B.A. (Cantab.), B.Sc. (Lond.), F.I.C., 3, Upper Gloucester-place, Marylebone-road, N.W.
1908	Trans.	Blyther, Donald Francis, B.Sc. (Lond.), 77, Knights-road, Silvertown, E.
1875		‖Boake, Arthur, Chemical Works, Stratford, E.; and Highstanding, Loughton, Essex
1902		Boardman, Ernest, B.Sc., (Vict.), 619, St. Helens-road, Bolton
1878		Bodmer, Richard, F.I.C., Analytical Laboratory, 16, Southwark-street, S.E.
1898		Bogert, Marston Taylor, Prof., B.A. and Ph.B. (Columbia), Columbia University, New York City, U.S.A.
1906		Bogue, Thomas Going Stoney, 5, Kenilworth-square, Dublin
1869	Trans.	‖Bolas, Thomas, F.I.C., 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, Edward Richards, 16, Flanchford-road, Ravenscourt Park, W.
1899		‖Bond, Alfred Ernest, Peterbrook, Warstock, near Birmingham
1883		Bond, Henry Charles, Rev. M.A. (Oxon.), Belle Vue Hall, Brighton
1893	Trans.	‖Bone, William Arthur, D.Sc. (Vict.), Ph.D. (Heidelberg), F.R.S., West House, Lidgett-park-road, Roundhay, Leeds
1893		Boone, William Thomas, B.Sc. (Lond.), 6, Sydenham-villas, Cheltenham
1884		Borland, William Dalrymple, F.I.C., Beacon Lodge, Green Street Green, near Dartford, Kent
1881		‖Borns, Henry, Ph.D. (Greifswald), 5, Sutton Court-road, Chiswick, W.
1895		‖Borradaile, Lancelot Alexander, M.A. (Cantab.), Selwyn College, Cambridge

Date of Election.		
1861		‖Bosanquet, Robert Holford Macdowall, M.A. (Oxon.), F.R.S., Castillo Zamora, Realijo Alto, Teneriffe, Canary Islands
1894	Proc.	Bose, Chuni Lal, Prof., 25, Mohendra Bose's-lane, Calcutta
1881		Bostock, George Henry, 217, Beatrice-street, Toronto, Canada
1881	Trans.	Bothamley, Charles Herbert, F.I.C., Tangle Wood, Southside, Weston-super-Mare
1887	Trans.	Bott, William Norman, Ph.D. (Heidelberg), 16, St. Helens-place, E.C.
1869		‖Bottomley, James Thomson, M.A., D.Sc., Hon. LL.D., (Glas.), F.R.S., 13, University-gardens, Glasgow
1886		Bottomley, William Beecroft, Prof., M.A. (Cantab.), Ph.D., 35, Downside-crescent, Hampstead, N.W.
1894		Boul, William Good, M.A. and LL.D. (Dub.), D.C.L. (Dun.), Tideswell Grammar School, near Buxton
1901		Bousfield, Edward George Paul, The Saxon Engineering Co., Ltd., Fenton, Stoke-on-Trent
1905	Trans.	Bousfield, William Robert, M.A. (Cantab.), K.C., St. Swithin's, Hendon
1891		Bovell, John Redman, Dodd's Botanical and Experimental Station, Barbados, West Indies
1865		‖Bowdler, Arthur Clegg, F.I.C., 20, Bank-terrace, Wellington-street, Blackburn
1888		Bower, Frank, c/o Messrs. Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, F.I.C., Messrs. Bowes and Sims, 40, Radford-street, Blackley, Manchester
1906		Bowis, William John, Ph.D. (Zürich), 97, North-road, West Bridgford, Notts.
1899		Bowles, Bertram Hennessey, Overdale, Eastwood-road, South Woodford, N.E.
1896		Bowley, Joseph John, 64, Redcliffe-gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, 4, Albert-square, Manchester
1862		Bowman, Frederic Hungerford, F.I.C., Assoc. Inst. C.E. and M.E., 4, Albert-square, Manchester
1896		‖Bowman, Herbert Lister, M.A. (Oxon.), Greenham-common, Newbury, Berks.
1894	Trans.	Boyd, David Runciman, Prof., D.Sc. (Glas.), Ph.D. (Heidelberg), F.I.C., The Hartley University College, Southampton
1901		Boyers, Henry, 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1903		Bradbury, Samuel, Ferncliff, Milton-grove, Glebelands-road, Ashton-on-Mersey, Cheshire

Date of Election		
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Aberfeldy, Southwick, near Brighton
1876		‖Bradley, Nathaniel, Sunnyside, College-road, Whalley Range, Manchester
1888		Bradshaw, Charles, 169, Spring Vale-road, Sheffield
1906		Braid, Arthur Forbes, Sewaren House, Sewaren, N.J., U.S.A.
1894	Trans.	Brame, John Samuel Strafford, Royal Naval College, Greenwich, S.E.
1903		Branch, George Thomas, c/o Messrs. Strachan & Co., Chemists, Umtali, Rhodesia, S. Africa
1904		Brand, Herbert Frank, M.A. (Lond.), 13, Clifton-road, Brockley, S.E.
1882		Branson, Frederick Woodward, F.I.C., 14, Commercial-street, Leeds; and Wynneholme, Far Headingley, Leeds
1908		Braun, Mario Joseph Arsène, Ph.D. (Bâle), 5, Aspinall-road, Brockley, S.E.
1882	Trans.	Brauner, Bohuslav, Prof., Ph.D. (Prague), Hon. D.Sc. (Manc.), New Chemical Laboratory, Bohemian University, Prague, VI., Bohemia
1896		Bray, Daniel, c/o W. Plowes, Esq., 45, Gothic-cottage, Old Goole, Goole, Yorks.
1905		‖Brettell-Vaughan, Edward Shipley Hewitt Edwards, 22, Vardens-road, Battersea, S.W.
1883		Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901		Bridges, Joseph Samuel, B.Sc. (Lond.), 45, Thistlethwaite-road, Clapton, N.E.
1904	Trans.	Bridgett, Robert Currie, M.A., B.Sc. (St. Andrews), Dunlossit, Dryburgh-avenue, Rutherglen, Glasgow
1897		Brierley, James, 33 and 35, French-street, Southampton
1890	Trans.	Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston
1898		Brierley, Joseph, B.Sc. (Vict.), Ashton-road, Failsworth, Manchester
1893	Trans.	Briggs, John Frederick, 2, Frankfort-road, Herne Hill, S.E.
1906		Briggs, Richard Victor, Research Station, Sirseah, Mozufferpore P.O., T.S. Railway, Bengal, India
1905	Trans.	Briggs, Samuel Henry Clifford, B.Sc. (Vict.), Greenbank, Cleckheaton, Yorks.
1883		‖Briggs, Thomas Lynton, F.I.C., 188, Central-avenue, Flushing L.I., U.S.A.
1884		‖Briggs, William, LL.D., D.C.L., M.A., B.Sc., Burlington House, Cambridge
1902		Brincker, John Augustus Herman, B.A., M.B., B.C. and D.P.H. (Cantab.), B.A. (Cape of Good Hope), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 8, Christ Church-road, Hampstead, N.W.

Date of Election.			
1900			Britten, Frank Curzon, B.A. (Oxon.), Odiham School, Odiham, Hants.
1889			Broadbent, Harry, F.I.C., 183, Hyde Park-road, Leeds
1879			‖Broadbent, John James, F.I.C., Bank-street, Irvine, N.B.
1883			Brock, John, J.P., F.I.C., Gwern-Tyno, Colwyn Bay, N. Wales
1893			‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth
1898			Brooke, Arthur, M.A. (Cantab.), The Grammar School, Caistor, Lincs.
1900			Brooke, Charles Berjen, Colne House, Brantham, near Manningtree, Essex
1900			Brooke, John Richard, F.I.C., The Government Laboratory, Singapore, Straits Settlements
1906			Broome, James Spears, M.Sc. (Manc.), 18, Seedley-park-road, Pendleton, Manchester
1886	Trans.		‖Brothers, Horace Edward, B.Sc. (Lond.), F.I.C., Clooney-park, Londonderry
1876	Trans.		Brown, Adrian John, Prof., M.Sc. (Birm.), F.I.C., West Heath House, Northfield, Worcs.
1867	Trans.	C. 1872-4, V.P. 81-4, 90-1. P. 91-3	Brown, Alexander Crum, Prof., M.A., M.D. (Edin.), D.Sc. (Lond.), LL.D. (Aberd.), F.R.S., F.I.C., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, F.I.C., 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, c/o Messrs. W. Ropes and Co., St. Petersburg, Russia
1873	Trans.	C. 1881-3	‖Brown, Frederic Douglas, Prof., B.Sc. (Lond.), University College, Auckland, New Zealand
1884			Brown, Frederic William, Ingleside, 39, Loveday-road, West Ealing, W.
1892			Brown, George Fitz-, A.R.S.M., F.I.C., The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, Gerald Noël, 20, Cullum-street, E.C.
1908			Brown, Harry James, Pembrey Lead Works, Burry Port, S.O., Carmarthenshire
1880			Brown, Henry, F.I.C., Benskin's Brewery, Watford, Herts.
1871	Trans.	C. 1883-7, V.P. 94-7, 1904-7 T. 1903-04 F.S. 1907-	†Brown, Horace Tabberer, LL.D. (Edin.), F.R.S., F.I.C., 52, Nevern-square, Kensington, S.W.
1908			Brown, James, 20, Tower-road, Dartford, Kent
1867	Trans.	V.P. 1908-	‖Brown, James Campbell, Prof., D.Sc. (Lond.), Hon. LL.D. (Aberd.), F.I.C., 8, Abercromby-square, Liverpool

† Longstaff Medallist, 1894.

Date of Election.		
1905		Brown, John Coggin, B.Sc. (Dun.), H.M. Geological Survey, Calcutta, India
1882		Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1892		Brown, Reginald Busby, c/o The Badische Co., Ltd., 2, Samuel Ogden-street, Manchester
1908		Brown, Walter, jun., Brookvale, Strathaven, N.B.
1884		Brown, William George, Prof., Ph.D. (N. Carolina), B.S. (Virginia), University of Missouri, Columbia, Missouri, U.S.A.
1896		Browne, Charles Edward, B.Sc. (Lond.), Christ's Hospital, West Horsham, Sussex
1893		Browne, Frank, F.I.C., Government Civil Hospital, Hong Kong, China
1873		Brownen, George, Grove-road-east, Avon-park, Christchurch
1899	Trans.	Browning, Kendall Colin, Prof., M.A. (Cantab.), Medical College, Colombo, Ceylon
1890		Brownsword, Frank, M.Sc. (Vict.), F.I.C., Bryn Derwen, Old Colwyn, N. Wales
1902		Bruce, Alexander, B.Sc., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1894	Trans.	Bruce, James, B.Sc. (Lond.), PhD. (Munich), A.R.C.S., F.I.C., The Technical College, Huddersfield
1901		‖Bruce-Kingsmill, Julian, Major, R.A., M.A. and B.Sc. (Glas.), c/o Messrs. E. S. Hindley & Sons, Engineers, Bourton, Dorset
1895		Bruckmann, Gustav Theodore, B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1903		Brühl, Paul, Civil Engineering College, Sibpur, near Calcutta, India
1898	Trans.	‖Brünnich, Johannes Christian, F.I.C., Department of Agriculture, Brisbane, Queensland
1893	Trans.	‖Brunton, John Dixon, c/o Prof. O. W. Richardson, Princeton, N.J., U.S.A.
1902		Bryant, Vernon Seymour, B.A. (Cantab.), Trelawne, Crowthorne, Berks.
1877	Trans.	‖Buch, Carl von, M.A. (Oxon.), F.I.C., 36, Great Marylebone-street, W.
1877	Trans.	Buchanan, John Young, M.A. (Cantab.), F.R.S., F.I.C., 26, Norfolk-street, Park-lane, W.
1876		‖Buckmaster, Charles Alexander, M.A. (Oxon.), F.I.C., 16, Heathfield-road, Mill Hill Park, Acton, W.
1902		Bucknell, Edwin Thomas Holman, Kingsholme School, Weston-super-mare.
1907	Trans.	Buckney, Frank, B.A. (Cantab.), Custom House, Rangoon, Burma

Date of Election.		
1903		Buggé, Erasmus Robert, 296, Burdett-road, Stepney, E.
1898	Trans.	Bull, Benjamin Samuel, M.A., B.Sc. (Ch. Ch. N.Z.), Ph.D. (Munich), F.I.C., Greylands, 104, Humber-road, Blackheath S.E.
1901		Bult, Herbert John, 18, Billiter-street, E.C.
1890		Bunting, Henry Herbert, Oficina de Ensayes F. C. C. del Peru Callao, Peru
1896		Burbridge, James Kerry, F.I.C., The Orchard, Philip-lane Tottenham, N.
1891		Burford, Samuel Francis, Beechworth, Stoneygate-road Leicester
1901		Burgess, Percival James, M.A. (Cantab.), Woodstock, Pinner Middlesex
1884		Burgess, William Thomas, F.I.C., 20, Priory-road, Bedford Park, W.
1903		Burghard, William Godsell, 43, New Oxford-street, W.C.
1884		‖Burland, Jeffrey Hale, 342, Sherbrooke-street, West Montreal Canada
1897		Burland, Richard Oxley, J.P., Poolstock House, Wigan
1901		‖Burnett, Theodore Ridley, B.Sc. (Vict.), Ph.D. (Bâle), Th Grammar School, Kirkby Lonsdale, Westmoreland
1893		Burnham, John Charles, B.Sc. (Vict.), F.I.C., Cordite Factory Wellington, Nilgiri Hills, India
1882	Trans.	Burrell, Benjamin Arthur, F.I.C., 8, Springfield Mount, Leeds
1902	Trans.	Burrows, Harry, Ph.D. (Heidelberg), A.R.C.S., F.I.C., Th Green, Southgate, N.
1901	Trans.	Burrows, Merrick William, M.Sc. (Vict.), Dunkirk, Devizes
1905	Trans.	Burt, Bryce Chudleigh, B.Sc. (Lond.), Department of Agriculture, Cawnpore, India
1891		Burton, William, Clifton Junction, near Manchester
1901		Burton, William, B.A. (Cantab.), B.Sc. (Wales), 47, Humberstone road, Cambridge
1903		Bury, Ernest, M.Sc. (Vict.), Brackley Coke Works, Little Hulton near Bolton, Lancs.
1894		Bush, William, School of Science and Art, Free Library Newport, Mon.
1904		Busher, Thomas Story, B.A. (Oxon.), Park Villa, Kendal
1890		Butcher, William James, B.Sc. (Lond.), Queen Elizabeth Grammar School, Ashbourne, Derbyshire
1895		Butler, David Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston Birmingham
1894		Buttemer, Robert William, St. Mary's, Godalming, Surrey
1875		Butterfield, John Cope, F.I.C., 79, Endlesham-road, Balham, S.W

Date of Election.		
1892		Butterfield, William John Atkinson, M.A. (Oxon.), F.I.C., 66, Victoria-street, S.W.
1902		Buxy, Tarit Kanti, Prof., Govt. College, Jubbulpore, C.P., India
1888		Byrn, George Alexander, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1906		Byrom, Thomas Henry, F.I.C., The Laboratory, Wigan Coal and Iron Co., Ltd., Wigan
1903		Bywaters, Hubert William, Ph.D. (Würzburg), A.R.C.S., F.I.C., 11, Kingly-street, W.
1903		Cadman, William Henry, B.Sc. (Wales), Ministry of Education, Cairo, Egypt
1893		‖Cahill, Robert Saunderson, Sunnyside, Heckmondwike
1894	Trans.	‖Cain, John Cannell, D.Sc. (Vict. and Tübingen), 28, Pembury-road, Clapton, N.E.
1906		Calam, Harold, M.Sc. (Leeds), B.Sc. (Vict.), F.I.C., 71, Cemetery-road, Beeston-hill, Leeds
1904		Caldecott, Lawrence, 56, Stanley-street, Fairfield, Liverpool
1898	Proc.	Caldecott, William Arthur, B.A. (Cape of Good Hope), Box 67, Johannesburg, S. Africa
1891		‖Calder, William Alexander Skeen, Ormidale, Little Moor-hill, Smethwick, near Birmingham
1907		Caldwell, Kenneth Somerville, B.Sc. (Wales), Ph.D. (Leipzig), F.I.C., Chemical Laboratory, St. Bartholomew's Hospital, E.C.
1904	Trans.	Caldwell, Robert John, D.Sc. (Lond.), Ivanhoe, Whatman-road, Honor Oak Park, S.E.
1906	Trans.	Caldwell, William, M.A. (R.U.I.), Physiological Department, Trinity College, Dublin
1884		Caley, Edward James, Chapel Field Works, Norwich
1907		Callan, Thomas, B.Sc. (Manc.), 22, Church-street, Egremont, Cheshire
1903	Trans.	Calvert, Harry Thornton, Ph.D. (Leipzig), M.Sc. (Leeds), B.Sc. (Vict.), F.I.C., West Riding of Yorkshire Rivers Board, Wakefield, Yorks.
1900		Calvert, Sidney, A.M. (Harvard), B.Sc. (McGill Univ.), State University, Columbia, Miss., U.S.A.
1894		Cameron, Alexander, Whitcher-place, Rochester-road, Camden Town, N.W.
1907	Trans.	Cameron, Alexander Thomas, M.A. and B.Sc. (Edin.), Chemical Laboratory, University College, Gower-street, W.C.
1875		Cameron, John Macdonald, F.I.C., Castle Hill, Tain, N.B.
1892		Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burma
1905		Campbell, Eric William, 49, Brougham Street, Greenock, N.B.
1905		Campbell, James Haig, Argyle, Carfin-road, Motherwell, N.B.
1903		Campbell, Thomas, 38, Eastbourne-street, Liverpool

Date of Election			
1898			Campion, Alfred, F.I.C., 144, Wellington-street, Glasgow
1896			Candy, Hugh Charles Herbert, B.A., B.Sc. (Lond.), F.I.C., The College, London Hospital, E.
1898			Cannon, Matthew James, 16 and 17, Devonshire-square, Bishopsgate-street, E.C.
1900			Cantin, Angélo, Prof., Royal College of Mauritius, Vacoas, Mauritius
1888			Carey, Alfred Edward, M.Inst.C.E., 36, Victoria-street, S.W.
1892	Trans.		Carey, Arthur, B.Sc. (Vict.), 1, Grassendale-road, Grassendale, near Liverpool
1906			Carmichael, John, 10, Cortayne-road, Fulham, S.W.
1902			Carmichael, Thomas Burnell, Parton, Whitehaven
1889			Carmody, Patrick, Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.		‖Carpenter, Henry Cort Harold, Prof., M.A. (Oxon.), Ph.D. (Leipzig), The University, Manchester; and 11, Oak-road, Withington, Manchester
1908			Carpenter, John Arthur, B.A, (Oxon.), 23, Richmond-road, Exeter
1906			Carpenter, Percy Henry, A.I.C., Sugar Works, Cawnpore, India
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895	Trans.		Carr, Francis Howard, F.I.C., Kelvin, Church-avenue, Sidcup, S.O., Kent
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks.
1902			Carrodus, Fred, Glen Fern Tower, Lansdowne-road, Wimbledon, S.W.
1882			‖Carruthers, Robert, Kirkbank House, Dumfries
1893			Carswell, Thomas Retson, 9, Camden Hill-road, Upper Norwood, S.E.
1864		C. 1878-82, 84-8	‖Carteighe, Michael, F.I.C., Oriel, Goring, Reading
1901	Trans.		Carter, William, Sewage Works, Bury
1867			‖Carulla, Facundo Joaquin Ramon, Argyll-terrace, 84, Rose-hill-street, Derby
1895			Case, Thomas Bennett, B.A. (Oxon.), Brewers' Laboratory, Messrs. Guinness, Son & Co., Dublin
1879			‖Cassal, Charles Edward, Col., V.D., F.I.C., Town Hall, Kensington, W.
1903			Castell-Evans, John, F.I.C., Carn Dochan, 4, Ranelagh-gardens, Ilford, E.
1894			Catherall, Ezra, A.R.C.S., Heathmere, Albany-road, Harborne, Birmingham

Date of Election.			
1907			Caton, Frederic William, B.A. (Oxon.), B.Sc. (Lond.), 6, King-street, Snow-hill, E.C.
1903			‖Caudwell, Ben, B.A. (Lond.), 28, Wigfull-road, Sheffield
1898	Trans.		Caven, Robert Martin, D.Sc. (Lond.), F.I.C., University College, Nottingham
1902			Challen, Matthew Bradbury, School of Mines, Daylesford, Victoria, Australia
1874			Chaloner, George, Combe House, Colyton, Axminster
1880			Chamberlain, Arthur Garratt, 3, Market-place, Rugby
1906			Chamberlain, Percy Garratt, M.A. (Cantab.), 3, Market-place, Rugby
1883			‖Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			‖Chance, Alexander Macomb, c/o Messrs. Chance and Hunt, Ltd., Chemical and Cement Works, Oldbury
1902			‖Chance, Kenneth Macomb, M.A. (Cantab.), 14, Cornwall-terrace, Regent's Park, N.W.
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York City, U.S.A.
1889			‖Chaplin, Edward Mitchell, Ph.D., Public Analyst's Office, Wakefield
1886	Trans.	C. 1908-	Chapman, Alfred Chaston, F.I.C., 8, Duke-street, Aldgate, E.C.
1895			Chapman, Arthur Jenner, F.I.C., Baronsmere, Stanhope-avenue, Church-end, Finchley, N.
1898	Trans.		Chapman, David Leonard, B.A. (Oxon.), Jesus College, Oxford
1899	Trans.		Chapman, Edgar Marsh, F.I.C., Cairnsmore, Manor-road, Scarborough
1891			Charles, Rhys Pendrill, F.I.C., Plâs Newydd, Neath
1900			Chater, Arthur Brand, 65, Queen-street, Brisbane, Queensland
1894	Trans.	C. 1900-03	Chattaway, Frederick Daniel, M.A. (Oxon.), D.Sc. (Lond.), Ph.D. (Munich), Hon. B.Sc. (Birm.), F.R.S., F.I.C., Longfield, Kenton-road, Harrow
1895			Cheadle, Walter William, M.A. (Oxon.), 36, London-road, Grays, Essex
1899			Cheater, Thomas John, B.Sc. (Lond.), 3, The Mansions, Star and Garter, Putney, S.W.
1900			Cheeseright, John Henry, B.Sc. (Lond.), 7, Claremont-place, Gateshead-on-Tyne
1887			Chenhall, James Warne, M.Inst.C.E., Dart-villas, Totnes, Devon
1897	Trans.		Chikashigé, Masumi, D.Sc. (Kyoto), College of Science and Engineering, Imperial University, Kyoto, Japan
1897			Cholerton, Alfred Foster, c/o Messrs. A. de St. Dalmas & Co., 40½, Belgrave-gate, Leicester
1891	Trans.		‖Chorley, John Christmas, Bewsey, Oxford-road, Birkdale, Lancs.

Date of Election.			
1907			‖Christie, John, B.A. (Cantab.), Eton College, Windsor
1874			Christopher, George, Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William James, F.I.C., 7, West George-street, Glasgow; and Shawfield Works, Rutherglen, near Glasgow
1906	Trans.		Chrystall, Edwin Rodney, B.Sc. (Lond.), A.I.C., Prospect House, Cliffe-at-Hoo, Kent
1856	Trans.	{C. 1876-80, 87-90}	‖Church, Arthur Herbert, Prof., M.A., D.Sc. (Oxon.), F.R.S., F.I.C., Shelsley, Kew, Surrey
1903			Clacher, William, c/o Miss Cuthbert, 33, Upper Kelly-street, Greenock, N.B.
1888	Trans.		Claisen, Ludwig, Geh. Rath Prof., Ph.D. (Bonn), Augustastrasse 24, Godesberg-am-Rheim, Germany
1901	Trans.		Clark, Ernest, B.Sc. (Lond.), Royal Technical Institute, Salford; and 16, Havelock-street, Sheffield
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1905			Clark, Friend Ebenezer, Prof., B.Sc. (Virg.), Ph.D. (Johns Hopkins Univ.), The Central University of Kentucky, Dannville, Ky., U.S.A.
1905			Clark, Thomas Walter Firth, 24, Witherington-road, Highbury, N.
1908			‖Clarke, Hans Thacher, Gayton-corner, Harrow
1906	Trans.		Clarke, Reginald William Lane, F.I.C., 15, Torridon-road, Hither Green, S.E.
1905			Clarkson, George Douglas, King-street, Mirfield, Yorks.
1902			Claudet, Arthur Crozier, A.R.S.M., F.I.C., 6 and 7, Coleman-street, E.C.
1882	Proc.		Clayton, Edwy Godwin, F.I.C., 23, Holborn-viaduct, E.C.
1904			Clayton, Ellis, Municipal Technical Institute, Belfast
1893			Clayton, George, Northern College of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, 3 and 5, Concert-street, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A. (Oxon.), F.I.C., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, F.R.S., 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, William, Sewage Outfall Works, Wolverhampton
1878			Cloud, Thomas Charles, A.R.S.M., F.I.C., Coronation House, 4, Lloyds-avenue, Fenchurch-street, E.C.
1907	Trans.		Clough, George William, B.Sc. (Birm.), 29, Oseney-crescent, N.W.
1902			Clough, William Thomas, A.R.C.S., Chelladene, St. Margaret's-road, Wanstead Park, Essex

Date of Election.			
1869	Trans.	C. 1885-90, 99-03	‖Clowes, Frank, Prof., D.Sc. (Lond.), F.I.C., The Grange, College-road, Dulwich, S.E.; and 40, Craven-street, Charing Cross, W.C.
1902			Clowes, George Henry Alexander, Ph.D. (Göttingen), Gratwick Research Laboratory, University of Buffalo, U.S.A.
1897			Clutterbuck, Medwin Caspar, B.Sc. (Lond.), Ph.D. (Strassburg), 61, Beaconsfield-villas, Brighton
1905	Trans.		Coates, Joseph Edward, B.Sc. (Wales), Sunny Side, Oakamoor, Stoke-on-Trent
1887			Coates, William Henry, M.A., M.B. (Dun.), M.R.C.S., L.R.C.P. and L.S.A. (Lond.), 7, Albion-street, Hull
1896			Cobb, Walter William, M.A. (Oxon.), Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A. (Cantab.), Haileybury, Ontario Canada
1895			Coblentz, Virgil, Prof., Ph.D. (Berlin), 115-119, W. 68th-street, New York City, U.S.A.
1880			‖Cockburn, Arthur Cecil, Longfield Broom House, Hampton Wick, Middlesex
1906			Cockburn, Charles Taylor, 34, Queen's-gate, Dowanhill, Glasgow
1895	Trans.		Cockburn, George Bertram, B.A. and B.Sc. (Oxon.), The Rycelands, Taynton, Newent, Gloucester
1901			Cockburn, Thomas Kennedy, 148, Woodstock-avenue, Shawlands, Glasgow
1892			Cockerill, Thomas, Bolton, Colpetty-road, Colombo, Ceylon
1893			Cocking, Allan Thomas, Carhampton House, Four Oaks, Sutton Coldfield
1888			‖Cocking, Lewis Smith, Rashcliffe Dyewood Mills, Huddersfield
1902			Cockle, Charles, 44, Fairfield-road, Winchester
1901			Coddington, Eustace, M.A. (Cantab.), 131, St. James's-road, Upper Tooting, S.W.
1903			Codling, Arthur John, 5, Tavistock-square, W.C.
1881			‖Coffin, Walter Harris, The National Liberal Club, Whitehall-place, S.W.
1885	Trans.	C. 1908-	Cohen, Julius Berend, Prof., Ph.D. (Munich), B.Sc. (Vict.), The University, Leeds
1901			‖Cohen, Robert Waley, M.A. (Cantab.), 11, Sussex-square, W.
1907			Colebourn, William Arthur, 24, Locket-road, Wealdstone, Middlesex
1891	Trans.		Colefax, Arthur, M.A. (Oxon.), Ph.D. (Strassburg), 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, F.I.C., S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.

Date of Election.			
1883			Collenette, Adolphus, Brooklyn, Fort-road, Guernsey
1908			Collens, Archibald Edgar, Government Laboratory, Port of Spain, Trinidad
1873			‖Collens, Edward, Stourbank House, Stourport, Worcs.
1905	Trans.		Colles, William Morris, jun., B.Sc. (Lond.), Chemical Laboratory, School of Medicine, Cairo, Egypt
1881			Collett, John Marton, Hillfield, Gloucester
1885	Trans.	C. 1889-94,1900-1	‖Collie, John Norman, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., 16, Campden-grove, Kensington, W.
1908	Proc.		Collier, William Henry, 12, Oxford-gardens, Bayswater, W.
1897			Collingridge, Frank, B.Sc. (Lond.), F.I.C., 73, Fountain-road, Edgbaston, Birmingham
1892			‖Collins, Hugh Brown, B.Sc. (Glas.), Auchinbothie Estate Office, Kilmacolm, S.O., Renfrewshire, N.B.
1890			‖Collins, Sydney Hoare, M.Sc. (Dun.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1888			Collins, Walter Hepworth, c/o Messrs. Edward Wihl & Co., 17, Nicholas-street, Manchester
1905			Collitt, Bernard, 79, Eastbourne-terrace, Gainsborough
1887	Trans.		‖Colman, Harold Govett, Ph.D. (Würzburg), M.Sc. (Vict.), F.I.C., Elmside, Worcester Park, Surrey
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900			Comber, Albert Walter, F.I.C., Suramangalam, Salem District, S. India
1892			‖Comyns, Frank, M.A. (Oxon.), Bryum, Craven-street, Newbury, Berks.
1899			Connah, James, B.Sc. (Lond.), F.I.C., The Laboratory, Custom House, E.C.
1875			Connor, Charles Cunningham, B.A. (Q.U.I.), 4, Queen's-elms, Belfast
1883			‖Conrad, Edwin Charles, 24, Felbrigge-road, Seven Kings, Essex
1906			Conyngham, William Boulton, Otter Works, Manchester
1902			Cook, Arthur James, 167, Richmond-road, Hackney, N.E.
1875	Trans.		‖Cook, Ernest Henry, D.Sc. (Lond.), F.I.C., The Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895			Cook, Herbert William, B.Sc. (Lond.), The Technical Institute, Tunbridge Wells, Kent
1907			Cook, Taylor, B.Sc. (Lond.), A.R.C.S., 20, Studdridge-street, Parson's Green, S.W.
1890			Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888			Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889			Cooper, Albert, 80, Gloucester-road, S. Kensington, S.W.

Date of Election.		
1898		‖Cooper, Albert John Bullen, Grimston Lawn, Haven-green, Ealing, W.
1892		Cooper, Arthur James, B.A. (Dub.), B.Sc. (Lond.), F.I.C., Brewood School, Staffs.
1888		Cooper, Astley, Stone, Greenhithe, Kent
1908		Cooper, Charles Duncan, 776, Oxford-road, Reading
1906		Cooper, Herbert Reginald, B.Sc. (Lond.), Redington, Northwood, S.O., Middlesex
1904		Cooper, Jabez Horace, B.A. (Oxon.), 13, Victoria-terrace, Exeter
1898		Cooper, John Burdon, M.D., B.S., B.Sc. (Dun.), 22, The Circus, Bath
1900		Cooper, William Francis, B.A. (Cantab.), 7, Grosvenor-road, Watford
1891		‖Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897		Cooper, William Ranson, M.A., B.Sc. (R.U.I.), A.C.G.I., A.I.C., 113, Tulse Hill, S.W.
1894	Proc.	Coote, Arthur Herbert, B.Sc. (Lond.), Garwood, 36, Humber-road, Blackheath, S.E.
1899	Trans.	Cope, Frank, Swindon Villa, Dewsbury
1907		Copping, Hugh Hague, B.A. (Dub.), Cabourne Parva, Caistor, Lincs.
1890		‖Coppock, John Bridgeford, B.Sc. (Lond.), F.I.C., Education Department, County Hall, Wakefield
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts.
1901	Trans.	Cormack, William, c/o Messrs. G. Nelson Dale & Co., Emscote Mills, Warwick
1888		‖Cornish, Vaughan, D.Sc. (Vict.), 157, Westbourne-grove, W.
1906		Cornwall, Reginald de Vere, Medical and Public Health Dept., Salisbury, Rhodesia, S. Africa
1890		Corrie, David, Nobel's Explosives Co., West Quarter Factory, Polmont Station, N.B.
1893	Trans.	Coste, John Henry, F.I.C., Eutopia, Gloucester-road, Teddington, Middlesex
1892		‖Couldrey, Henry, c/o Messrs. Thos. Cook & Son, Ludgate-circus, E.C.
1905		Coupe, Miles, Rosebank, Thornfield-road, Waterfoot, near Manchester
1906	Trans.	Courtauld, Stephen Lewis, B.A. (Cantab.), 2, Friars-walk, Burton-on-Trent
1900		Courtman, Ernest Owen, Denford House, Atkins road, Clapham Park, S.W.
1903		‖Cousins, Francis George, 16, Old Elvet, Durham

Date of Election.		
1901	Trans.	Cousins, Herbert Henry, M.A. (Oxon.), Government Laboratory, Kingston, Jamaica
1885		Cousins, William James, F.I.C., 17, Temple-chambers, Temple-avenue, E.C.
1886	Trans.	‖Coutts, Francis James Henderson, M.D., B.Ch., D.P.H. (Vict.), 264, Hornby-road, Blackpool
1908		Coverdale, Arthur Edward, 68, Broad-street, Worcester
1907		Cowap, Matthewman Dalton, 15, Alexandra-road, St. John's Wood, N.W.
1906	Trans.	Coward, Hubert Frank, M.Sc. (Manc.), Hulme Hall, Victoria-park, Manchester
1898		Cowburn, Arthur William, 29, Princess-street, Manchester
1908		Cowburn, John Robert, 10, Eastwood-road, South Woodford, Essex
1882		‖Cowie, Thomas Rennie, Garnkirk House, Garnkirk, N.B.
1905		Cowie, William Beaverly, 26, East Claremont-street, Edinburgh
1898		Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873		Cownley, Alfred John, F.I.C., 26, Barry-road, Dulwich, S.E.
1905		Cowman, Douglas Henry Bellars, The English College, Jerusalem, Palestine
1904		Cowper, Alfred Denys, University College, Gower-street, W.C.
1888		Cowper, Joseph, 50, King-street, Penrith
1886		Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898		Cox, Frederick Hudson-, F.I.C., 46, St. James'-road, Brixton, S.W.
1873		Cox, Samuel Herbert, 13, St. Helen's-place, E.C.
1904		Crabb, William, B.Sc. (Lond.), 7, Edridge-road, Croydon
1870	Trans.	Crafts, James Mason, Prof., 111, Commonwealth Avenue, Boston, Mass., U.S.A.
1892	Trans.	Craig, Andrew William, College of Pharmacy, 360, Swanston-street, Melbourne, Victoria
1897		Cranfield, William, The Higher Grade Board School, Halifax
1897		Creasey, Clarence Hamilton, Beechwood, Thorn-park-road, Plymouth
1887		‖Cribb, Cecil Howard, B.Sc. (Lond.), F.I.C., 136, Shaftesbury-avenue, W.
1908	Trans.	Crichton, David Cowan, M.A. and B.Sc. (St. Andrew's), A.I.C., Backhill House, Musselburgh, N.B.
1878		‖Criper, William Risdon, A.R.S.M., F.I.C., Chemical Works, Konnagar, Calcutta, India
1907		Crisp, George Hugh, B.A. (Oxon.), 62, Gainsboro'-road, Crewe
1895		Crocker, Charles, Norman House, St. Peter's-road, Cockett, Swansea

Date of Election.			
1906			Crocker, Henry Ernest, 446, Slade-road, Erdington, Birmingham
1902	Trans.		Crocker, James Codrington, M.A. (Cantab.), D.Sc. (Lond.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1901			Crocker, Walter Stevens, A.R.C.S., 39, Arnold-street, Princes Park, Liverpool
1897	Trans.		Crofts, James Murray, M.A. (Cantab.), B.Sc. (Lond.), The College, Barnato Park, Johannesburg, S. Africa
1907			Croghan, Edward Henry, Laboratory, Simmonds-street, Johannesburg, S. Africa
1886	Trans.		‖Crompton, Holland, Oaklyn, Cross Oak-road, Berkhamsted
1902			Crookes, Henry, 109, Ladbroke-grove, Notting Hill, W.
1901	Trans.		Crookes, Samuel Irwin, Marama-avenue, Owen's-road, Epsom, Auckland, New Zealand
1857	Trans.	C. 1866-70 V.P. 76-9, 85-7 P. 87-9	‖Crookes, Sir William, D.Sc. (Oxon., R.U.I., Cape of Good Hope), F.R.S., F.I.C., 7, Kensington Park-gardens, W.; and Athenæum Club, Pall Mall, S.W.
1879	Trans.	C. 1890-1, 93-5	‖Cross, Charles Frederick, B.Sc. (Lond.), F.I.C., 3, New-court, Carey-street, W.C.
1890	Trans.	C. 1901-2 S. 1905-	‖Crossley, Arthur William, Prof., D.Sc. (Vict.), Ph.D. (Würzburg), F.R.S., F.I.C., Pharmaceutical Society, 17, Bloomsbury-square, W.C.; and 10, Crediton-road, West Hampstead, N.W.
1896			Crossman, Charles Matthew, B.Sc. (Lond.), Cannon House, Watford, Herts.
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1898			Crouch, William Samuel, 265, Glossop-road, Sheffield
1880	Trans.		Crow, John Kent, D.Sc. (Lond.), F.I.C., Ivydene, Westcombe-park-road, Blackheath, S.E.
1887			‖Crowther, Horace Woodward, F.I.C., The Beeches, West Bromwich
1895			Croysdale, John, Whitley Bridge, S.O., Yorks.
1884			Crumbie, William Drake, 146, Washington-street, East Orange, N. J., U.S.A.
1887	Trans.		Cundall, James Tudor, B.Sc. (Lond.), F.I.C., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1904			Cunningham, James Edward, Minas Peña del Hierro, Provincia del Huelva, Spain
1907			Cunningham, John Arthur, Prof., B.A. (Cantab. and R.U.I.), A.R.C.S.I., The Observatory, Alipore, Calcutta, India
1898	Trans.		Cunnington, Alfred Valentine, B.A. (Cantab.), c/o Messrs. Brunner, Mond & Co., Northwich
1875			Curphey, William Salvador, F.I.C., 7, Derby-crescent, Kelvinside, Glasgow

Date of Election.		
1900		Cussons, John, B.Sc. (Vict.), High School, Aliwal North, Cape Colony, S. Africa
1881		‖Custance, John D., Prof., Broad View, Georgetown, S. Australia
1895		Cuthbertson, Lionel Mould Gurney, 89, Lordship Park, N.
1894		Dains, Herbert Henry, F.I.C., 27, Inderwick-road, Stroud Green, N.
1901	Trans.	Dakin, Henry Drysdale, D.Sc. (Vict.), F.I.C., 819, Madison avenue, New York, U.S.A.
1907		Dall, Colin Ernest, B.Sc. (Lond.), Maisonette, Maybury-road, Woking, Surrey
1905		Dallman, Arthur Augustine, Lyndhurst, Prospect-vale, Liverpool
1904		Dalton, William Herbert, 85, Hayter-road, Brixton Hill, S.W.
1901	Trans.	Daniel, Gilbert Howard, B.Sc. (Lond.), 25, Church-walk, Ulverston
1887		Daniell, Louis Charles, Royal Standard Brewery, Tamworth, N.S.W.
1902		Daniels, James Ward, Westwood, Medomsley, S.O., Co. Durham
1892	Trans.	Darbishire, Francis Vernon, B.A. (Oxon.), Ph.D. (Leipzig), South Eastern Agricultural College, Wye, Kent
1852		Darby, Stephen, F.I.C., Cookham Dean, Berks.
1899		Darling, Charles Robert, A.R.C.S.I., F.I.C., Bryniach, Brent-road, Plumstead, Kent
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	‖Darling, William Howarth, F.I.C., 26, Dover-street, Manchester
1875		‖Davey, G. William, 2, Compton-avenue, East Ham, E.
1905		Davey, Joseph Morgan, Shelone House, Briton Ferry, Glam.
1897		Davidge, Henry Norris, 23, Rydal-road, Streatham, S.W.
1900		Davidson, Alexander, jun., F.I.C., 173, Colinton-road, Edinburgh
1906		Davidson, Charles, 65, Cadder-street, Pollokshields, Glasgow
1907		Davidson, Francis, c/o The Seth C. Nutter Brewery, Ltd., Cornwall, Ontario, Canada
1901		Davidson, John Howard, B.Sc. (Vict.), Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell-green, Halifax
1898	Trans.	Davidson, William Brown, M.A., D.Sc. (Aberd.), Ph.D. (Würzburg), F.I.C., Saltley Gas Works, Birmingham
1866	Trans.	‖Davies, Arthur Ellson, Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, The Laboratory, 28, Chapel-street, Liverpool
1905		Davies, John Llewelyn, B.A. (Cantab.), The Perse School, Cambridge
1896		Davies, Llewellyn John, Bute-chambers, Bute-road, Cardiff

Date of Election.			
1894			Davies, Samuel Henry, B.Sc. (Vict.), Rowntree's Cocoa Works, York
1900			Davis, Arthur Charles, 2, Downing-grove, Cambridge
1902			Davis, Charles Benson, c/o Dr. Francis Wyatt, S.W.-corner, 23rd-street and 9th-avenue, New York City, U.S.A.
1901			Davis, Francis, Forest Villa, Ovenden, Halifax, Yorks.
1902			Davis, Frederick, B.Sc. (Vict.), Hazel House, Hayfield, near Stockport
1902			Davis, Henry Wilson, F.I.C., Farleigh, Crescent-road, Kingston Hill, S.W.
1857			‖Davis, J. Frederick, c/o J. Lewis, Esq., Government Laboratory, Parliament-street, Cape Town, S. Africa
1872	Trans.		‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876			‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1897	Trans.		Davis, William Alfred, B.Sc. (Lond.), 2, Ashgrove-road, Bromley, Kent
1900			Davison, Thomas Cuthbert, Bower-hill, Exmouth-street, Swindon, Wilts.
1906			Davson, Archibald Prideaux, A.R.C.S., A.I.C., 72, Torridon-road, Catford, S.E.
1895			Daw, Frederic Weldon, A.R.C.S., F.I.C., Eureka-place, Ebbw Vale, Mon.
1900	Trans.		Dawson, Harry Medforth, D.Sc. (Leeds), B.Sc. (Lond.), Ph.D. (Giessen), The University, Leeds; and 25, St. Michael's-crescent, Headingley, Leeds
1890			Day, Charles Edwin, B.Sc. (Edin.), The Mines, Coniston, Lancs.
1881	Trans.		‖Day, Thomas Cuthbert, 36, Hillside-crescent, Edinburgh
1905			Day, William Walpole, B.Sc. (Wales), Llandilo, Attleborough-road, Nuneaton
1907			Dealy, Thomas Kirkman, Craigmin East, Magazine Gap, Hong Kong, China
1901	Trans.		Dean, George, M.A. (Cantab.), 38, Brisbane-road, Ilford, E.
1904			Deane, Harold, B.Sc. (Lond.), F.I.C., 11, Melfort-road, Sudbury, Suffolk
1886			Deane, Leopold Mandeville, 21, Station-terrace, Abbey Village, near Chorley, Lancs.
1859		{ V.P. 1871-4 }	Debus, Heinrich, Prof., Ph.D. (Marburg), F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1898	Trans.		‖De Castro, John Paul, M.A. (Cantab.), F.I.C., 1, Arundel-street, Strand, W.C.
1885	Trans.		Dechan, Martin, F.I.C., Laboratory of Public Analyst, Hawick
1903			Deeks, William Thomas, High-street, Shanklin, Isle of Wight

Date of Election.			
1869	Trans.		‖Deering, William Henry, I.S.O., F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël Fielding, Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, H.I., U.S.A.
1902			De la Rue, Evelyn Andros, B.A. (Oxon.), 110, Bunhill-row, E.C.
1905			De Lury, Ralph Emerson, M.A. and Ph.D. (Toronto), The Dominion Astronomical Observatory, Ottawa, Canada
1907			Denham, William Smith, B.Sc. (Lond.), F.I.C., 2, Kelvinside-terrace-north, Glasgow
1892			Denison, Joseph Richard, Lingholme, Heaton, Bradford
1902			Dennis, William, High-street, Mundesley-on-Sea, S.O., Norfolk
1906			Denton, John, Horton Villa, Bradford
1903	Trans.		Desch, Cecil Henry, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Instow, Mount Pleasant-road, South Tottenham, N.
1897			‖Deverell, Louis Charles, Straits Trading Co., Singapore, Straits Settlements
1870	Trans.	C. 1874-7 V.P. 80-3 86-8, 96-7 P. 97-9	‖Dewar, Sir James, Prof., M.A. (Cantab.), Hon. LL.D. (St. Andrews, Aberd., Edin., Glas.), Hon. D.Sc. (Oxon., Dub., Vict., Ireland), F.R.S., F.I.C., Royal Institution, Albemarle-street, W.
1899			Dewhirst, John Arthur, F.I.C., 13, Highfield-terrace, Nab Wood, Saltaire, Bradford
1880			Dibdin, William Joseph, F.I.C., Purley Bury, Purley-downs-road, Sanderstead, Croydon
1872			‖Dickinson, Arthur John, F.I.C., Truro Villa, 57, Lewisham-high-road, S.E.
1908	Trans.		Dickinson, Cyril, B.Sc. (Vict. and Leeds), F.I.C., 17, Hollycroft-avenue, Hampstead, N.W.
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1906			Dickson, William, Branksome, Bridge-of-Weir, N.B.
1907			Dikshit, Mohan Nath Kedarnath, Amliran, Surat, India
1906			Dinwoodie, James Herbert, 71, Bree-street, Johannesburg, S. Africa
1860	Trans.	C. 1873-4 V.P. 1900-03	‖Divers, Edward, Prof., M.D. and Hon. D.Sc. (R.U.I.), F.R.S., F.I.C., 3, Canning-place, Palace Gate, W.
1897			Dixon, Andrew James, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1885	Trans.	C. 1900-06	Dixon, Augustus Edward, Prof., M.D. (Dub.), Queen's College, and Fernhurst-avenue, Western-road, Cork
1896	Trans.		Dixon, Frank, B.Sc. (Lond.), The Institute, Lydney, Gloucester
1894	Proc.		‖Dixon, George, M.A. (Cantab.), Trinity College, Cambridge; and St. Bees, S.O., Cumberland
1876	Trans.	C. 1892-6 V.P. 1904-7	‖Dixon, Harold Baily, Prof., M.A. (Oxon.), F.R.S., The University, Manchester
1893			Dixon, Harry William, 32, Grange-view, Chapeltown-road, Leeds

Date of Election.			
1895			Dixon, William, 102, Spring-street, Bury
1862			Dixon, William Adam, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1882	Trans.	C.1901-6 V.P. 1907-	Dobbie, James Johnston, Prof., M.A. (Glas.), D.Sc. (Edin.), F.R.S., F.I.C., Museum of Science and Art, Edinburgh
1887	Trans.		Dobbin, Leonard, Ph.D. (Würzburg), F.I.C., Chemical Laboratory, New University-buildings, Edinburgh
1898			‖Dodd, Frederick Robertson, F.I.C., Victoria-villas, 139, Burscough-street, Ormskirk
1901			Dodd, Robert, 56, Valley-road, Streatham, S.W.
1886			Dodd, W. Ralph, Trederwen, Village-road, Enfield, Middlesex
1892			Dodds, George Price, 14, St. Luke's-terrace, Darlington
1905			Dodds, Roger, Kingswood School, Bath
1897	Proc.		Dodgson, John Wallis, B.Sc. (Lond.), University College, Reading
1894	Proc.		Doherty, William Michael, F.I.C., Government Laboratory, Sydney, N.S.W.
1905			Donald, Robert, M.A., B.Sc. (N.Z.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Oxon.), Mental Hospital, Orokonui Home, Waitati, New Zealand
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1901	Trans.		Donnan, Frederick George, Prof., M.A. (R.U.I.), Ph.D. (Leipzig), Muspratt Laboratory, The University, Liverpool
1897	Trans.		Dootson, Frederick William, M.A. (Cantab.), D.Sc. (Dub.), F.I.C., University Chemical Laboratory, Cambridge
1902	Trans.		Dorée, Charles, M.A. (Oxon.), B.Sc. (Lond.), 87, Gore-road, N.E.
1899			Dougall, James Dick, Senhouse-street, Maryport, Cumberland
1888			‖Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1905			Doull, John, 22, Lauriston-place, Edinburgh
1884			Down, Frederick Johnathan, Glengariff, Milton-road, Harpenden, Herts.
1899			Doyle, Frederick, Oakdene, Scotland-road, Stanwix, Carlisle
1898			Drake, Francis Alfred, B.Sc. (Lond.), Balerno, Hornsea, East Yorks.
1884			Draper, Henry Carter, 68, Wodehouse-terrace, North Circular-road, Dublin
1891	Proc.		Dreaper, William Porter, F.I.C., Woodcroft, Felixstowe, S.O., Suffolk
1893			Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1906			Drinkwater, Lionel John, Burford, Oxon.
1902			Drought, James Justinian, Molo, *viâ* Mombasa, British East Africa

Date of Election.		
1895		Druce, Edric, County Agricultural Institute, Ridgmont, Aspley Guise, S.O., Beds.
1904	Trans.	Drugman, Julien, Ph.D. (Bonn), 33, St. Michael's-road, Headingley, Leeds
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1907		Duckworth, Samuel, M.Sc. (Vict.), 78, Alexandra-road, Lowestoft
1901		Duckworth, William Henry, Weaste House, Borough-road, Salford
1899		Dudderidge, Frank Rawlinson, Brecknock House, Blandford
1898		Dudley, Charles Benjamin, Ph.D. (Yale), Drawer 334, Altoona, Pa., U.S.A.
1890		‖Dudley, William Lofland, Prof., Vanderbilt University, Nashville, Tenn., U.S.A.
1892		Duffield, Walter William, 5, Ashington-road, Hurlingham, Fulham, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A. (Cantab.), D.Sc. (Lond.), Laurel Bank, Claremont-road, Headingley, Leeds
1897		Dufty, Lawrence, 119, Rustling-road, Sheffield
1884		Duggan, Thomas Richard, F.I.C., 60, Foyle-road, Blackheath, S.E.
1889		Duisberg, Carl, Prof., Ph.D., Elberfeld, Germany
1889		‖Dukes, Thomas William, P.O. Box 10, Vryheid, S. Africa
1881		Duncan, Arthur William, 1, Trafalgar-road, Higher Bentcliffe, Pendleton, Manchester
1894	Proc.	‖Duncan, Cecil Cooke, F.I.C., The Shire Hall, Worcester
1906		Duncan, Robert Kennedy, Prof., University of Kansas, Lawrence, Kansas, U.S.A.
1891		Duncan, William, F.I.C., The Laboratory, 65, Bath-row, Edgbaston, Birmingham
1896		Duncan, William, Royal Dispensary, 21, West Richmond-street, Edinburgh
1905		Dunlop, Harry, c/o Messrs. R. R. Tatlock and R. T. Thomson, 156, Bath-street, Glasgow
1894	Proc.	‖Dunn, Frederic, 193, Collins-street, Melbourne, Australia
1882		Dunn, John Thomas, D.Sc. (Dun.), F.I.C., 10, Dean-street, Newcastle-on-Tyne
1893		Dunnington, Francis Perry, University of Virginia, Charlottesville, U.S.A.
1899		Dunscombe, Frederick Charles, c/o Electric Reduction Co., Buckingham, Quebec, Canada
1901	Trans.	Dunstan, Albert Ernest, B.Sc. (Lond.), East Ham Technical College, East Ham, E.
1885		Dunstan, Malcolm James Rowley, M.A. (Oxon.), F.I.C., The College, Wye, Kent

Date of Election.			
1905			Dunstan, Sydney, The Royal Infirmary, Newcastle-on-Tyne
1879	Trans.	C. 1888-91 S. 93-1903 V.P. 1903-06	‖Dunstan, Wyndham Rowland, Prof., Hon. M.A. (Oxon.), Hon. LL.D. (Aberd.), F.R.S., F.I.C., Imperial Institute, S.W.
1907			Dupré, Frederick Harold, Mount Edgcumbe, Sutton, Surrey
1907			Dupré, Percy Vivian, A.C.G.I., F.I.C., Mount Edgcumbe, Sutton, Surrey
1896			Durant, Henry Thomas, The Rhodesia Gold Fields, Ltd., Bulawayo, Matabeleland, S. Africa
1871			‖Durham, Henry, 13, Colcherne-road, South Kensington, S.W.
1906			Durrans, Thomas Harold, B.Sc. (Lond.), 1, Cornwall-terrace, Regent's Park, N.W.
1883	Trans.		Durrant, Reginald Graham, M.A. (Oxon.), The College, Marlborough, Wilts.
1908			Dutt, Bidhu Bhushan, Prof., M.A. (Calcutta), Presidency College, Calcutta, India
1907			Dutton, Francis Bridger, Common Room, Lincoln's Inn, W.C.
1892			Duxbury, Thomas, 17, Grosvenor-chambers, Deansgate, Manchester
1875	Trans.	C. 1893-7 1904-08	‖Dyer, Bernard, D.Sc. (Lond.), F.I.C., 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, F.I.C., Board of Education, South Kensington, S.W.
1883	Trans.		‖Dyson, Septimus, 44, Fairmile-avenue, Streatham, S.W.

1905			Eade, Samuel George, Farndish Rectory, Wellingborough
1908	Trans.		Eagles, Edwin Mortimer, M.A. (Cantab.), Winsham-Grove, Clapham Common, S.W.
1876			‖Earp, Francis Salsbury, Ph.D. (Giessen), F.I.C., 35, Porter-street, Kalgoorlie, W. Australia
1907			Eastaugh, Frederick Alldis, A.R.S.M., The University, Sydney, N.S.W.
1889	Trans.		‖Easterfield, Thomas Hill, Prof., M.A. (Cantab.), Ph.D. (Würzburg), F.I.C., Victoria University College, Wellington, New Zealand
1891			Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
1881			Eastick, John Joseph, A.R.S.M., F.I.C., Ashburton, Northfield-road, Stamford Hill, N.
1903			Eastwood, Arthur William, B.A. (Cantab.), Newton College, Newton Abbot
1906			Eaton, Bertie James, A.I.C., Institute of Medical Research, Kuala Lumpur, Selangor, Federated Malay States

Date of Election.		
1878	Trans.	‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1906		Edgell, Cecil Wyatt-, B.A. (Oxon.), Cowrey-place, Exeter
1903		Edgerton, John Percy, The Laboratory, 61, Cornhill, E.C.
1902		Edlin, Edgar Leeder, B.A. (Oxon.), 31, All Saints-road, Leicester
1902		Edminson, Sidney Robert, B.Sc. (Lond.), Maritzburg College, Natal, S. Africa
1893		Edwards, Thomas, Ty Mawr, Rhymney, viâ Cardiff
1884		Edwards, Vincent, F.I.C., c/o Lawes' Chemical Manure Co., Barking Creek, Essex
1892		Edwards, Walter Nicholas, 6, Shardcroft-avenue, Herne Hill, S.E.
1898		‖Edwards, Wilbraham Tollemache Arthur, M.R.A.C., F.I.C., Town Hall, Port Louis, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rheim, Germany
1899		Eichenauer, William Frederick, 18, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, F.I.C., 143, New Bond-street, W.
1883		‖Ekins, Arthur Edward, J.P., F.I.C., Rushden, Lattimore-road, St. Albans
1903		Elford, Archibald Sefton, M.A. (Oxon.), 41, Broomfield-road, Chelmsford
1891		Elford, Percy, M.A. (Oxon.), 115, Woodstock-road, Oxford
1907		Elias, Owen Aubrey, 123, Waller-road, New Cross, S.E.
1878	Trans.	‖Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, Walter John, M.A. (Cantab.), Woodcroft, Lichfield-road, Stafford
1893		Ellis, Charles Sordes, F.I.C., Meadowlead, Station-road, Harrow
1900		Ellis, Frederic Richard, c/o Messrs. H. Hodder & Co., Ltd., 11 & 12, Wine-street, Bristol
1903	Proc.	Ellis, Henry Russel, B.Sc. (Lond.), 179, Warwick-road, Kensington, W.
1878		Ellis, William Hodgson, Prof., M.A. (Cantab.), M.B. (Toronto), F.I.C., School of Practical Science, Toronto, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1893		Elmore, Alexander Stanley, 4, Broad-street-place, E.C.
1902		Elsden, Alfred Vincent, B.Sc. (Lond.), F.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E.
1885		Embrey, George, F.I.C., County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton, The Copse, Hamble, Southampton

Date of Election.			
1901			English, Robert, Christchurch Gas Co., Christchurch, New Zealand
1892			Entwistle, Herbert, 1, Albert-place, Dickenson-road, Longsight, Manchester
1899			Epps, James Washington, 159, King's-avenue, Clapham Park, S.W.
1889			Erskine, James Kerr, New Kleinfontein Co., Ltd., Post Office, Benoni, Transvaal, S. Africa
1883	Trans.		Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862			‖Esson, William, Prof., M.A. (Oxon.), F.R.S., Merton College, Oxford
1865			‖Estcourt, Charles, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1899			‖Estcourt, Harry Estcourt, 467, West-street, Durban, Natal, S. Africa
1888			‖Estcourt, Philip Anderson, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1894			Eumorfopoulos, Nicholas, B.Sc. (Lond.), 33, Gloucester-square, Hyde Park, W.
1905			Evans, Bernard Scott, B.Sc. (Lond.), 42, Keymer-road, Streatham, S.W.
1904			Evans, Edward, The Laboratory, South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1891			Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope, S. Africa
1906			Evans, Frederick Watkins, 11, High-street, Cardigan
1904			Evans, John, F.I.C., 67, Surrey-street, Sheffield
1904			Evans, Novil Norton, McGill University, Montreal, Canada
1892	Trans.		‖Evans, Robert Cecil Turle, M.R.C.S. (Eng.), L.R.C.P., L.S.A., D.P.H. and B.Sc. (Lond.), Sandringham House, Marine-crescent, Herne Bay, Kent.
1888			‖Everard, Arthur George, 43, Clapham-road, S.W.
1902			Everitt, Walter, Norwood Wharf, Southall, Middlesex
1894			Evershed, Frank, Kenley, Surrey
1896	Trans.		Ewan, Thomas, M.Sc. (Vict.), Ph.D. (Munich), c/o Cassel Cyanide Co., Ltd., Shuna-street, Maryhill, Glasgow
1902	Trans.		Eynon, Lewis, B.Sc. (Lond.), F.I.C., 57, Darenth-road, Stamford Hill, N.
1901	Trans.		Eyre, John Vargas, Ph.D. (Leipzig), 26, Bridge-road-west, Battersea Park, S.W.

Date of Election.			
1888			Faber, Harald Nicolai, 7 and 8, Idol-lane, E.C.
1904			Fagan, Thomas Wallace, M.A. (Cantab.), Talysarn, Penygroes, S.O., Carnarvonshire
1903			Fairhall, Edwin Jesse, A.C.G.I., A.I.C., 96, Blackstock-road, Finsbury Park, N.
1865	Trans.		‖Fairley, Thomas, F.I.C., 17, East-parade, Leeds
1895			Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899			Fairweather, Ernest Barratt, King's College Hospital, Lincoln's Inn Fields, W.C.
1908			Fairweather, James Hill, 62, Wythes-road, Silvertown, E.
1908			Falk, Kaufman George, B.Sc. (Columbia), Ph.D. (Strassburg), 1070, Madison-avenue, New York City, U.S.A.
1888			Farlie, John Burke, 54, Wellington-road, Old Charlton, Kent
1906			Farmer, Charles George Edgar, 16, Herbert-crescent, S.W.
1907			Farmer, John Edwin, Blelsoe, New-road, Mitcham Junction, Surrey
1903	Trans.		Farmer, Robert Crosbie, D.Sc. (Vict.), Ph.D. (Würzburg), St. Katherine's, Southwood-road, New Eltham, Kent
1895			Farr, Edward Henry, Uckfield, Sussex
1870			‖Farries, Thomas, F.I.C., 16, Coleman-street, E.C.
1880			‖Farrington, Thomas, M.A. (Q.U.I.), F.I.C., 5, Summerhill-terrace, Wellington-road, Cork
1907			Fawcitt, Claude Scott, 11, St. Mark's-road, Bangalore, India
1887			Fawsitt, Charles Albert, 9, Foremount-terrace, Dowanhill, Glasgow
1903	Trans.		Fawsitt, Charles Edward, D.Sc. (Edin.), Ph.D. (Leipzig), Chemical Department, The University, Glasgow
1906	Proc.		Feilmann, Martin Ernest, B.Sc. (Lond.), Ph.D. (Bâle), F.I.C., 92, Victoria-street, S.W.
1897			Fenby, Alarick Vincent Colpoys, B.Sc. (Lond.), Windsor-villas, Penwortham, Preston
1878	Trans.	{C. 1898-1902}	‖Fenton, Henry John Horstman, M.A. and Sc.D. (Cantab.), F.R.S., F.I.C., Christ's College, and 19, Brookside, Cambridge
1898			Ferguson, James Edward, Laboratory and Assay Office, 2, Union-court, Old Broad-street, E.C.
1872		C. 1889-93	‖Ferguson, John, Prof., M.A. (Glas.), LL.D. (St. Andrews), F.I.C., The University, Glasgow
1901			Ferguson, Reginald Williams, B.Sc. (Lond.), A.R.C.S., Municipal Technical School, The Gamble Institute, St. Helens
1899			Fermor, Herbert Frederick Francis Burdett, 32, Trossacks-road, East Dulwich, S.E.
1902			Ferrand, Frederick, 13, Torrington-street, Hopwood, Heywood
1882			Ferrier, James, P.O. Box 764, Rome, Georgia, U.S.A.
1905			Ferrier, John Greig, 6, Brunswick-square, Port of Spain, Trinidad, West Indies

Date of Election.			
1902			Ferrier, John Oliver, 58, Clock House-road, Beckenham, Kent
1902			Ferris, Percy James, Willowmore, New-road, Lymm, Cheshire
1906			Field, Samuel, A.R.C.S., 64, Lanercost-road, Tulse Hill, S.W.
1904			Field, William Eddington, Martin-street, Elsternwick, Melbourne, Australia
1895			Fielding, Patrick Joseph Dominick, 66, Patrick-street, Cork
1906	Trans.		Fierz, Hans Eduard, Ph.D. (Zürich), Wissenshaftliche Station für Brauerei, 42a, Ohlmüller-strasse, Münich, Germany
1900	Trans.		Findlay, Alexander, M.A., D.Sc. (Aberd.), Ph.D. (Leipzig), The University, Birmingham
1908			Findley, Albert Edward, B.Sc. (Birm.), 1, Welford-road, Handsworth, Birmingham
1905			Findon, Frank Standish, Rev., M.A. and B.Sc. (St. Andrews), 41, Great Percy-street, Holford-square, W.C.
1904			Finlow, Robert Steel, B.Sc. (Wales), c/o Messrs. Grindlay and Co., Calcutta, India
1905	Trans.		Finnemore, Horace, B.Sc. (Lond.), F.I.C., High Leasow, Coulsdon, S.O., Surrey
1907			Fischer, Eugen, Ph.D. (Zürich), c/o Messrs. Kalle & Co. Aktiengesellschaft, Biebrich-am-Rheim, Germany
1896			Fisher, Ernest Hunter, The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A. (Oxon.), F.I.C., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Sir Frederick William, Bart., M.A. (Oxon.), 64, Pont-street, S.W.
1906			Fitzgerald, Anthony Nisbet, B.A. and B.Sc. (Lond.), 12, St. Mary's-road, Strood, Rochester
1900			FitzGibbon, Thomas, 115, Harbord-street, Fulham, S.W.
1896			Fleet, John Thomas, 24, Sheep-street, Rugby
1899	Trans.		‖Fleischmann, Friederich Noël Ashcroft, M.A. (Oxon.), 4, Orme-court, W.
1898			‖Fleming, John Arnold, Britannia Pottery, 136, Glebe-street, Glasgow
1874			Fletcher, Frederick William, North London Chemical Works, Holloway, N.; and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A. (Oxon.), F.R.S., Natural History Department, British Museum, Cromwell-road, S.W.; and 35, Woodville-gardens, Ealing, W.
1894			‖Flintoff, Robert John, Gale Print Works, Littleborough, Lancs.
1892			Floris, Robert Brooke, F.I.C., Church House, West Hanningfield, near Chelmsford
1906	Trans.		Flürscheim, Bernhard, Ph.D. (Heidelberg), Heatherlands, Fleet, Hants.

Date of Election.			
1894			Fogg, Charles Albert, Graythorne, Albert-road, Bolton
1859			Fogg, Thomas, 93, Portsdown-road, Maida Vale, W.
1889			Foggie, John, University College, Dundee
1902			Foll, Edgar, The Cottage, The Lion Brewery, Belvedere-road, Lambeth, S.E.
1885			Follows, Harold, 4, Kensington-avenue, Victoria-park, Manchester
1894			‖Forbes, Donald Gordon, Room 35, Board of Trade Building, Victoria, British Columbia
1874			Forbes, James, St. Kitts, Bexhill-on-Sea
1889	Trans.		Ford, John Simpson, c/o Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1907			Foreman, Charles Thomas, Jamalpur, East Indian Railway, Bengal, India
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton, Surrey
1904			Forrest, John Kerr, Hawsleigh, Balaclava-road, St. Kilda, Victoria, N.S.W.
1893			Forrester, Alexander Machattie, c/o Messrs. Laidlaw, MacKill and Co., Ltd., 3400, Williamsburg-avenue, Richmond, Va., U.S.A.
1905			Forster, Ernest Lyle Carman, M.A. (Toronto), 317, Queen-street, Ottawa, Canada
1892	Trans.	C. 1901-04. S. 1904-	‖Forster, Martin Onslow, D.Sc. (Lond.), Ph.D. (Würzburg), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W. ; and 84, Cornwall-gardens, South Kensington, S.W.
1903			Forster, William, 30, Church-street, Seaham Harbour
1856	Trans.	C. 1865-8. 72-5, 85-6. V.P. 88-92.	‖Foster, George Carey, Prof., B.A. (Lond.), LL.D. (Glas.), D.Sc. (Vict.), F.R.S., Emeritus Professor of Physics, University College, Gower-street, W.C. ; and Ladywalk, Rickmansworth, Herts.
1872			Foster, Reginald Le Neve, Bollindene, Wilmslow, Cheshire
1906			Foucar, James Louis, B.Sc. (Lond.), 20, St. John's-park, Blackheath, S.E.
1906			Foulds, James, A.R.C.S., 92, Crown-terrace, Blackburn-road, Darwen, Lancs.
1898			Foulerton, Alexander Grant Russell, F.R.C.S. (Eng.), L.R.C.P., (Lond.), D.P.H. (Cantab.), Haywards Heath, Sussex
1891	Trans.		‖Fowler, Gilbert John, D.Sc. (Vict.), F.I.C., Broad Oak, Urmston, Manchester
1900			Fowler, Morris Broad, 19, Westbury-road, Westbury-on-Trym, near Bristol
1882			‖Fowler, William, 1, Grace-terrace, Sunderland
1907			Fowles, George, 28, Weltje-road, Hammersmith, W.

Date of Election.			
1895			Fox, Albert Stanley, Rosehurst, Athelstan-road, Faversham
1907	Trans.		Fox, John Jacob, 6, Alkham-road, Stamford Hill, N.
1907			Foxell, Edward William Lanchester, B.Sc. (Lond.), Barnes, Christ's Hospital, West Horsham, Sussex
1906			Foye, Peter Bertram, 16, Burlington-road, Dublin
1908			Francies, Joseph Valentine, Civil Engineering College, Sibpur, Calcutta, India
1879			Francis, Edward, Ivy Bank, Park-ravine, Nottingham
1902	Trans.		Francis, Francis Ernest, Prof., Ph.D. (Erlangen), D.Sc. (Vict.), F.I.C., University College, Bristol
1873			‖Francis, George Bult, 38, Southwark-street, S.E.
1881			Frankland, Henry, F.I.C., Streonshalh, The Crescent, Linthorpe, Middlesbro'.
1880	Trans.	C. 1887-9 V.P. 1902-05.	‖Frankland, Percy Faraday, Prof., Hon. LL.D. (St. Andrews), Ph.D. (Würzburg), Hon. M.Sc. (Birm.), B.Sc. (Lond.), A.R.S.M., F.R.S., F.I.C., The University, Birmingham
1867			‖Fraser, Angus, M.A., LL.D. (Aberd.), M.D., C.M. (Aberd. and Paris), 232, Union-street, Aberdeen
1892			‖Fraser, James Christopher, Mercantile-chambers, Victoria-square, Adelaide, S. Australia
1885			Freear, Harry Marshall, Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick William, Heatherdale, Spenser-road, Harpenden, Herts.
1900			Freeman, Willie Ludford, M.A. (Oxon. and Dub.), LL.B. (Dub.), 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph Thomas, Limehurst, Plymyard-avenue, Bromboro', Cheshire
1892	Proc.		French, William, M.A. (Cantab.), F.I.C., Storey Institute, Lancaster
1903	Trans.		Friend, John Albert Newton, M.Sc. (Birm.), Ph.D. (Würzburg), The Manse, Mildenhall, S.O., Suffolk
1890			‖Frost, Robert, B.Sc. (Lond. and Vict.), 55, Kensington-court, Kensington, W.
1904			‖Fry, George, Carlin Brae, Berwick-on-Tweed
1899			Fry, George Cecil, M.Sc. (Leeds), F.I.C., Devon County School, West Buckland, South Molton, Devon
1899	Trans.		Frye, Colin Charlwood, 11, King's-avenue, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A. and Ph.D. (Leipzig), F.I.C., 13, Eaton-crescent, Clifton, Bristol
1907			Fryer, Percival John, 27, Minster-road, Cricklewood, N.W.
1891			Fulcher, Lionel William, B.Sc. (Lond.), Victoria and Albert Museum, S.W.; and Ingleside, 37, Kempshott-road, Streatham Common, S.W.
1896			Fuller, Charles James Pemeller, 603, Chorley-new-road, Horwich, near Bolton, Lancs.

Date of Election.		
1886		Fuller, John, Rookwood, 24, Mount-park-crescent, Ealing, W.
1894		‖Gabb, George Hugh, 83, Crayford-road, Tufnell-park, N.
1899		Gabriel, Edmund Vivian, M.A. (Cantab.), C.V.O., The Pines Southern-road, Southbourne, Christchurch
1901		Gadd, Henry Wippell, 27, East Southernhey, Exeter
1901		Gajjar, Tribhuvandas Kalyandas, Prof., M.A. and B.Sc. (Bombay) Gingaum, Bombay, India
1908		Gale, Robert Cecil, 38, Scarsdale-villas, Kensington, W.
1905		Gall, John Beaconsfield, A.C.G.I., F.I.C., 7, Linden-grove Nunhead, S.E.
1903		Gandy, William Hunter, Bradley Court, Mitcheldean, Glouceste
1908	Trans.	Ganguli, Atul Chandra, Prof., B.A. (Calcutta), Ravensha College, Cuttack, Orissa, India
1883	Proc.	‖Garbutt, Llewellyn, M.A. (Cantab,), The College, Winchester
1903		Gardiner, Ernest Alexander, M.A. (Oxon.), The College Plymouth
1888		Gardiner, James Henry, 59, Wroughton-road, Balham, S.W.
1905		Gardner, Charles Richard, Chemical Laboratory, Gathurst, nea Wigan
1906		Gardner, Edward, 70, Parliament-hill-mansions, Highgate-road N.W.
1901		Gardner, Hermann Charles Thomas, Miller Hospital and Roya Kent Dispensary, Greenwich-road, S.E.
1893	Trans.	Gardner, John Addyman, M.A. (Oxon.), F.I.C., Chemica Department, St. George's Hospital, S.W.
1888		Gardner, Walter Myers, Prof., M.Sc. (Leeds), Technical Colleg Bradford ; and 3, Fairmount, Manningham, Bradford
1902		Garle, John Longsdon, F.I.C., 136, Holland-road, Kensington, W
1893	Trans.	Garnett, Henry, 32, Dover-street, Manchester
1889	Trans.	Garrett, Frederic Charles, M.Sc. (Vict.), Armstrong College Science, Newcastle-on-Tyne
1898		Garside, Arthur Leonard Harry, 6, Cotswold-terrace, Low Broughton-road, Manchester
1906		Garvey, Richard Godfrey Hamilton, c/o Commonwealth Oil Co poration, Ltd., Equitable-buildings, George-street, Sydne N.S.W.
1884		Gaskell, Joseph, 71, Haworth's-buildings, Cross-street, Mancheste
1900		Gasson, William, Dutoitspan-road, Kimberley, S. Africa
1903		Gatehouse, Frank Brooks, Cement Works, Dartford, Kent
1904	Trans.	Gawler, Robert, M.Sc. (Vict.), 3, South View-terrace, Bennet road, Headingley, Leeds
1887		Geisler, Joseph Frank, Mercantile Exchange Buildings, Hudso and Harrison-streets, New York City, U.S.A.

Date of Election.		
1885		Gemmell, George Harrison, F.I.C., 4, Lindsay-place, Edinburgh
1903		Gent, Percy William, 697, Clifton-avenue, Forest Hill, Newark, N.J., U.S.A.
1879		‖Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Director of Technical Instruction, Auckland, New Zealand
1889		‖Gerland, Conrad, M.Sc. (Vict.), Ph.D. (Marburg); Meadow Bank, Accrington
1891		German, George, jun., Mansion House, Ashby-de-la-Zouch
1895		‖Gerrans, Henry Tresawna, M.A. (Oxon.), 20, St. John-street, Oxford
1875		Gerrard, Alfred William, Westward Ho, Wake-green-road, Birmingham
1899		Getman, Frederick Hutton, 811, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Lieut.-Col. I.M.S., M.B. (Aberd.), F.I.C., Chemical Examiner, Medical College, Madras, India
1904		Ghose, Anu, 42, Shambazar-street, Calcutta, India
1890		‖Gibbes, Cuthbert Chapman, M.D. and C.M., (Aberd.), M.R.C.P. (Lond.), D.P.H. (Cantab.), 89, Harley-street, W.
1900		Gibbings, George William, Standard Bank of South Africa, Salisbury, Rhodesia, S. Africa
1897		Gibbons, Joseph Lake, Secondary School, Blyth, Northumberland
1906		Gibbs, Reginald William Malyon, B.A. (Cantab.), B.Sc. (Lond.), Findon Villa, Tennyson-avenue, King's Lynn, Norfolk
1907	Trans.	Gibson, Charles Stanley, B.A. (Oxon.), M.Sc. Tech. (Manc.), 45, Shakspeare-street, Manchester
1900		Gibson, John, St. Oswald's road, Hexham
1892	Trans.	Gibson, John, Prof., Ph.D. (Heidelberg), F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1907		Gibson, William Howieson, B.Sc. (Lond.), 79, Elliscombe-road, Charlton, S.E.
1888		Gibson, William Humphrey, 122, King's-road, Brighton
1898		Gidden, William Thomas, The Hawthorns, Moat-road, Langley, near Birmingham
1895		Gilbard, John Francis Hutchins, F.I.C., 245, Dalston-lane, Hackney, N.E.
1904		Gilchrist, James Gray, M.A. (Aberd.), B.Sc. (Lond.), 15, Links-place, Musselburgh, N.B.
1898		Gilderdale, Frederick, 32, Treherne-road, High West Jesmond, Newcastle-on-Tyne
1883		‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants.
1888		Gill, John, Gwealhellis, Helston, Cornwall

Date of Election.		
1902		Gill, J. Arthur, Pennsylvania, Lower-green-road, Rusthall, Tunbridge Wells
1898	Proc.	Gilles, William Setten, A.C.G.I., F.I.C., The Cottage, Bocking, Braintree, Essex
1905		Gillies, Albert, Government Laboratories, Johannesburg, S. Africa
1908	Proc.	Gilling, Charles, 30, Carnarvon-road, Barnet, Herts.
1901		Gillman, Edward, Government Laboratory, Barbados, West Indies
1885		Girdwood, Gilbert Prout, M.D. and C.M. (McGill Univ.), M.R.C.S. (Eng.), F.I.C., 111, University-street, Montreal, Canada
1897		Girtin, Thomas, M.A. (Cantab.), c/o H. L. Raphael's Refinery, Thomas-street, Burdett-road, Limehouse, E.
1898		Glaister, John, Prof., M.D. (Glas.), M.R.C.S. and L.R.C.P. (Edin.), 18, Woodside-place, Glasgow
1905		Glass, Archibald Melville, B.Sc. (Lond.), 37, Chancery-lane, W.C.
1907		Gledhill, Walter George, M.A. (Cantab.), The School House, Woodbridge
1872		‖Glover, George Thomas, F.I.C., 24, Craven-hill-gardens, Lancaster Gate, W.
1904		Glover, Harry James, Mount Pleasant, Wrattle-road, Westham, near Hastings
1906	Trans.	Glover, Walter Hamis, Ph.D. (Leipzig), 38, Ribblesdale-road, Streatham Park, S.W.
1907	Trans.	Godden, William, B.Sc. (Lond.), A.R.C.S., A.I.C., Station-road-east, Canterbury
1899		Golding, John, F.I.C., Midland Agricultural and Dairy Institute, Kingston, Derby
1878		‖Goldschmidt, S. A., Ph.D., c/o Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, N.Y., U.S.A.
1889		Goldsmith, Byron B., Ph.B. (Columbia), 19, East 74th-street, New York City, U.S.A.
1898		Goldsmith, John Naish, B.Sc. (Vict.), Ph.D. (Heidelberg), 55, Chancery-lane, W.C.
1899		Goltz, Harold Francis Carl, 155, Brixton Hill, S.W.
1897		Gomess, Alfred Francis Bilderbeck, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 33, Drayton-gardens, South Kensington, S.W.
1904		‖Goodson, John Augustus, F.I.C., Gordon College, Khartoum, Egypt
1890		Goodwin, Thomas Small, Prof., M.B. and C.M. (Glas.), F.R.S.E., 1, Heron-terrace, St. Margarets, Twickenham
1896	Trans.	Goodwin, William, B.Sc. (Manc.), Ph.D. (Göttingen), South-Eastern Agricultural College, Wye, Kent
1890		Gordon, Colin, Storer's Wharf, Cubitt Town, E.

Date of Election.			
1875			Gordon, Joseph Gordon, F.I.C., Queen Anne's-mansions, Westminster, S.W.
1905			Gorman, Henry Isaac, 126, Quay, Waterford, Ireland
1890			Gossling, Frank, B.Sc. (Lond.), H.M. Patent Office, Staple Inn, W.C.
1889	Trans.		‖Gott, Benjamin Scaife, M.A. (Cantab.), The Guildhall, Westminster, S.W.
1900			Gough, John Henry, 65, Grange-avenue, Chapeltown-road, Leeds
1879			Gough, Thomas, Rev., B.Sc., King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, D.Sc. (Lond.), F.I.C., 88, Sylvan-avenue, Chitts Hill, N.
1887			Gover, Herbert James, 29, Piccadilly, Hanley, Staffs.
1889			Gow, Robert John, Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, Ashleigh, Furness Park-road, Barrow
1871	Trans.	C. 1898-01, 1906-7	‖Gowland, William, Prof., A.R.S.M., F.R.S., F.I.C., 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George Arthur, Hawkins-road, Medindie, Adelaide, S. Australia
1862		C. 1880-1	‖Graham, Charles, Prof., D.Sc. (Lond.), F.I.C., The Reculvers, Hastings
1880	Trans.		‖Graham, Christopher Colborne, F.I.C., Oriel House, Scarborough
1890	Trans.		Grant, James, F.I.C., Oaklands, Gardner-road, Prestwich, near Manchester
1887			Gravill, Edward Day, 42, Walmsley-street, Hull
1882			‖Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900	Trans.		Gray, Robert Whytlaw, 7, Orme-court, Bayswater, W.
1892	Trans.		‖Gray, Thomas, Prof., D.Sc. (Glas.), Ph.D. (Jena), The Technica College, Glasgow
1895			Greaves, William Abraham, 23A, Broad-bank, Louth, Lincs.
1890			Green, Alfred Henry, A.I.C., Oaklands, Lowton, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, Prof., Hon. M.Sc. (Vict.), F.I.C., The University, Leeds; and 49, Cardigan-road, Headingley, Leeds
1902	Trans.		Green, Clarence James, B.Sc. (Vict.), c/o Messrs. Nicholson and Co., Beaumont Works, St. Albans
1905			Green, Ernest, 113, Hulton-street, Moss Side, Manchester
1902			Green, George Felix Dudbridge, A.I.C., c/o Messrs. Davey and Co., Gainsboro'-road, Hackney Wick, N.E.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, A.R.S.M., F.I.C., West Clyne, Stretford, Manchester

Date of Election.			
1878			Green, Lawrence, Lower Tovil, Maidstone
1908			Green, Leonard Clifford, B.E. (Sydney), Wienholt-street, Torwood, Brisbane, Queensland
1907			Green, William Heber, D.Sc. (Melbourne), The University, Melbourne, Australia
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey
1907			Greenough, Thomas Rigby, B.A. (Cantab.), Beechwood, Leigh, Lancs.
1885			Greenway, Thomas John, F.I.C., 60, Brookman's-buildings, Grenfell-street, Adelaide, S. Australia
1894	Proc.		Greeves, Alfred, 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D. and B.S. (Dun. and Cape of Good Hope), M.R.C.S. and D.P.H. (Eng.), B.Sc., Colonial Secretary's Office, Cape Town, S. Africa
1907			Gregory, Joshua Craven, B.Sc. (Lond.), F.I.C., 128, Wellington-street, Glasgow
1906	Trans.		Gregory, Thomas William Diggle, Lynton, Basford-park, Stoke-on-Trent
1874			Greville, Henry Leicester, F.I.C., 39, Croft-road, Bromley, Kent
1896			Grice, Walter Thomas, 9, Dalhousie-square, Calcutta, India
1907			Grieb, Christopher Maurice Walter, B.Sc. (Lond.), A.I.C., c/o Messrs. Lorimer & Co., Ltd., Britannia-row, Islington, N.; and 33, Torrington-park, North Finchley, N.
1888			‖Griffith, David Agnew, The Houghlands, Kelsall, Chester
1905			Griffiths, John, B.Sc. (Wales), The College, Cleobury Mortimer, Salop.
1902			Griffiths, John Thomas, 9, Greenhill-avenue, Tenby, S. Wales
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 3, Hill-side, Lancaster
1902			Grimwade, Wilfrid Russell, B.Sc. (Melbourne), 342–346, Little Flinders-street, Melbourne, Australia
1893			Grimwood, Robert George, F.I.C., 43, Leaside-avenue, Muswell Hill, N.
1906			Grindley, Harry Sands, Prof., D.Sc. (Harvard), B.Sc. (Illinois), State University, Urbana, Ill., U.S.A.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire
1900			Gritton, Henry Bertie, The Royal Mint, Sydney, N.S.W.
1895			Grossmann, Edward Henry, 12, Alfred-place-west, South Kensington, S.W.
1871	Trans.	C. 1877-8 V.P. 1899-1902.	‖Groves, Charles Edward, F.R.S., F.I.C., Kennington Green, S.E.

Date of Election.		
1905		Groves, Samuel Ernest, Ingleside, Bridle-road, South Boldon, Co. Durham
1901		Groves, William Peer, B.A. (Cantab.), Green Bank, Plumbley, Cheshire
1906		Grubb, David Paton, B.Sc. (Edin.), A.R.S.M., 1, Windsor-hill, Newry, Ireland
1897		Grundey, Frederick Roscoe, B.Sc. (Vict.), 33, Woodburn-square, Douglas, Isle of Man
1903		Grundy, Frank Barnes, F.I.C., Red Lodge, King's-road, Richmond, Surrey
1897		Guest, Edward Graham, M.A. (Cantab.), B.Sc. (Lond.), 5, Newbattle-terrace, Edinburgh
1902		Gumersall, Edward, 61, Hungerford-road, Camden-road, N.
1895		Gunn, Alexander, 3, Clitheroe-road, Clapham, S.W.
1902		Gunn, Gilbert, 181, Bury-new-road, Heywood, Lancs.
1906		Gupta, Hem Chandra Dutt, Prof., M.A. (Calcutta), Tej Narayan Jubilee College, Bhagalpur, Bengal, India
1899		Gurney, Elliott Henry, Agricultural College, Gatton, Queensland, Australia
1898		Guthrie, Alexander, B.Sc. (Lond.), Inglewood, Eaton-road, Coventry
1888	Trans.	Guthrie, Frederick Bickell, F.I.C., Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1904	Trans.	Guthrie, John Monteath, 199, Ferry-road, Leith, N.B.
1904	Trans.	Guttmann, Leo Frank, Ph.D. (Heidelberg), A.C.G.I., F.I.C., The College of the City of New York, New York City, U.S.A.; and 18, Aberdare-gardens, N.W.
1897		Guttmann, Oscar, M.Inst.C.E., F.I.C., 60, Mark-lane, E.C.
1902	Trans.	Haas, Paul, D.Sc. (Lond.), Ph.D. (Freiburg), 11, Westbourne-park-road, W.
1874		Habirshaw, William Martin, 341, Madison-avenue, New York, U.S.A.
1894		Hadley, Arthur, c/o Messrs. Crowley & Co., Ltd., The Brewery, Alton, Hants.
1898		Hadley, Edwin Bernard, Dalham Villa, Granville-road, Southfields, S.W.
1893		‖Hadley, Henry Edwin, B.Sc. (Lond.), A.R.C.S., School of Science, Kidderminster
1886	Trans.	Haga, Tamemasa, Prof., D.Sc. (Japan), College of Science, University of Tokio, Japan
1881		Hailes, Alfred James de, F.I.C., 15, Red Lion-square, W.C.

Date of Election.			
1892			Haines, Walter Stanley, Prof., c/o Rush Medical College, Chicago, Ill., U.S.A.
1876	Trans.		Hake, Henry Wilson, Ph.D. (Giessen), F.I.C., Westminster Hospital Medical School, Caxton-street, S.W.
1893			Hale, Henry Ormsby, Oundle School, Oundle
1891	Trans.	C. 1904–7	Hall, Alfred Daniel, M.A. (Oxon.), Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.
1889			Hall, Allan Twistleton, c/o Messrs. Sissons Bros. and Co., Ltd., Hull
1891			Hall, Archibald, F.I.C., 7, Fenchurch-avenue, E.C.
1889	Trans.		Hall, John Albert, M.Sc. (Manc.), Victoria Chemical Works, Victoria, British Columbia
1903			Hall, John Thomas, West View, Stanwell, Staines
1907			Hall, Joseph Henry, B.Sc. (Lond.), 84, The Grove, Wandsworth, S.W.
1906			Hall, Octavius, L.R.C.P. and L.R.C.S. (Edin.), L.F.P.S. (Glas.), D.P.H. (R.C.P.S.I.), 6, Devonshire-villas, Plymouth
1906			Hall, Richard John, M.Sc. (Vict.), F.I.C., Sandycroft, Serpentine-road, Egremont, Liverpool
1899			‖Hall, Samuel Godfrey, Hampsterly, Woodside-park, Finchley, N.
1908			Hall, William, B.Sc. (Vict.), Inglewhite, Manchester-road, Bolton
1886			Halliburton, William Dobinson, Prof., M.D., B.Sc. and F.R.C.P. (Lond.), M.R.C.S., (Eng.), F.R.S., Church Cottage, 17, Marylebone-road, N.W.
1897			Halliwell, Edward, F.I.C., c/o Ribble Joint Committee, 2, Stanley-place, Preston
1902			Hallowell, Thomas Butterworth, Ladyshawe House, New Mills, West Stockport
1900			Halstead, Reginald Gordon, 12 and 16, Coleman-street, E.C.
1890	Trans.		Hambly, Frederick John, F.I.C., c/o The Electric Reduction Co., Buckingham, Quebec, Canada
1906			Hamer, John, 158, Darwen-road, Bromley Cross, near Bolton, Lancs.
1888	Trans.		Hamilton, James Cullen, Barrows-green, near Kendal, Westmoreland
1898			Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks.
1897			Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans.		Hamlet, William Mogford, F.I.C., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1904			Hammond, Harold Sankey, Macdonald College, St. Anne de Bellevue, Quebec, Canada
1901			Hammond, Herbert Blackmore, 99, Barton-road, Dover

Date of Election.			
1857			Hanbury, Cornelius, F.I.C., Plough-court, Lombard-street, E.C.; and Manor House, Little Berkhamsted, Hertford
1900			Handcock, Walter Augustus, F.I.C., Pentlands, 39, The Avenue, Beckenham, Kent
1895	Trans.		Hanes, Edgar Septimus, F.I.C., 22, Lyncroft-mansions, Lyncroft-gardens, Hampstead, N.W.
1896			Hanger, Ralph Hamilton, Hawthorn-villa, Newland, Hull
1901			Hanley, John, F.I.C., 74, Rowson-street, New Brighton, Cheshire
1902	Trans.		Hann, Archie Cecil Osborn, 54, Wood-vale, Forest Hill, S.E.
1872	Trans.		‖Hannay, James Ballantyne, F.I.C., Cove Castle, Loch Long, N.B.; and Whitehall Club, S.W.
1889			‖Hanson, Alfred Miall, The Marjorie, Whalley, near Blackburn
1901	Trans.		Hanson, Edward Kenneth, M.A. (Cantab.), F.I.C., Woodthorpe, Royston-park-road, Hatch End, Middlesex
1906			Hanson, Harold Norman, Field Head, Brighouse, Yorks.
1895			Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on-Tees
1897			Harbord, Frank William, A.R.S.M., F.I.C., Surbiton House, Englefield Green, Surrey
1859	Trans.	S. 1865-73 V.P. 73-6, 80-3, 92-5 P. 1895-7	‖Harcourt, Augustus George Vernon, M.A. (Oxon.), Hon. D.Sc. (Oxon.), Hon. D.C.L. (Dun.), Hon. LL.D. (Montreal), F.R.S., F.I.C., St. Clare, Ryde, Isle of Wight
1887	Trans.	C. 1902-05	‖Harden, Arthur, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C., 2, Marlborough-road, Richmond, Surrey
1901			Harding, Herbert, B.Sc. (Lond.), 47, Streathbourne-road, Upper Tooting, S.W.
1892			Hardy, James Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1874			Hargreaves, Andrew Fuller, Esk Hill, Rosslyn, Midlothian
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes, Lancs.
1884			Hargreaves, John, F.I.C., Widnes, Lancs.
1900			Hargreaves, William Arthur, M.A., B.C.E. (Melbourne), F.I.C., Government Analyst, Adelaide, S. Australia
1900			Harker, George, D.Sc. (Lond.), 35, Boulevarde, Petersham, Sydney, N.S.W.
1876			‖Harland, Robert Henry, F.I.C., 37, Lombard-street, E.C.
1878			‖Harland, William Dugdale, 48, King-street, Manchester
1897			‖Harley, Vaughan Berkeley, Prof., M.D. (Edin.), M.R.C.P. (Lond.), 25, Harley-street, W.
1897			Harman, Harold Wallis, Felday, Links-road, Epsom, Surrey
1903			Harmer, Francis Gerald, Cockburn High School, Leeds

Date of Election.		
1904		Harold, Frederick Clarkson-, 7, Bolton-road, Port Sunlight, Cheshire
1899		Harper, Henry Winston, M.D. (Virginia), The University of Texas, Austin, Texas, U.S.A.
1897		Harrie, Harold William, 300, Christchurch-road, Boscombe, Bournemouth
1907		Harrington, Arthur George, A.I.C., c/o Dr. Middleton, Municipal Buildings, Singapore, Straits Settlements
1881		Harrington, William Bury, Leeview, Montenotte, Cork
1906		Harris, Frederick James, 37, St. Oswald's-road, Fulham, S.W.
1896		Harris, Frederick William, F.I.C., 26, John-street, Glasgow
1893		Harris, Harold, The Birmingham Metals and Munitions Co., Ltd., Ammunition Factory, Streetly, nr. Sutton Coldfield, Birmingham
1895		Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia
1894		Harris, Sydney Walters, Devon House, Walter-road, Swansea
1878		‖Harris, Thomas Frederick, B.Sc. (Lond.), Waterford House, Aylsham, Norfolk
1888		‖Harrison, Albert, Delamere, Grove-road, South Woodford, Essex
1894	Trans.	Harrison, Edward Frank, B.Sc. (Lond.), F.I.C., 55, Chancery-lane, W.C. ; and Langholm, Edgar-road, S. Croydon
1883		‖Harrison, Hugh Erat, B.Sc. (Lond.), 28, Sussex-place, Regent's Park, N.W. ; and Faraday House, Charing Cross-road, W.C.
1901		Harrison, John Ansted, B.Sc. (Lond.), A.R.C.S., 11, Foxhouses-road, Whitehaven
1888		Harrison, John Burchmore, C.M.G., M.A. (Cantab), F.I.C., Government Laboratory, Georgetown, Demerara, British Guiana
1902		Harrison, Walter Ernest, 15, Lansdowne-road, Handsworth, Birmingham
1901		Harry, Frederick Thomas, 106, Sandmere-road, Clapham Common, S.W.
1905		Hart, Alfred, M.A., B.Sc. (Melbourne), Norman-avenue, Hawksburn, Victoria, Australia
1886		Hart, Bertram Harvey, Rosslyn, High-street, Sidcup, S.O., Kent
1900		Hart, Herbert William, 5, Cambridge-road, Ansdell, Lytham, Lancs.
1891		Hart, William Beamont, F.I.C., Laboratory, 8, Exchange-street, Manchester
1882		Hartley, Arthur, The Brewery, Emsworth, Hants.
1897		Hartley, Ernald George Justinian, B.A. (Oxon.), The Bungalow, Foxcombe Hill, near Oxford
1899	Trans.	Hartley, Harold Brewer, M.A. (Oxon.), Balliol College, Oxford

Date of Election.			
1897			Hartley, Thomas, B.Sc. (Lond.), F.I.C., Swindon and North Wilts. Technical School, Swindon
1866	Trans.	C. 1877-80 V.P. 90-3	†Hartley, Walter Noel, Prof., Hon. D.Sc. (R.U.I.), F.R.S., F.I.C., Royal College of Science, St. Stephen's-green-east, and 10, Elgin-road, Dublin
1890	Trans.		Hartog, Philip Joseph, M.A. (Manc.), B.Sc. (Lond. and Vict.), University of London, South Kensington, S.W.
1900	Trans.		Hart-Smith, James, A.R.C.S., F.I.C., 4, Grafton-mansions, Venn-street, Clapham, S.W.
1900	Trans.		Harvey, Alfred William, 13, Pendrell-road, St. Catherine's-park, Hatcham, S.E.
1885			Harvey, Ernest William, A.R.S.M., Stoneleigh, 23, Grove-road, Clapham Park, S.W.
1881			Harvey, Sidney, F.I.C., Watling House, Canterbury
1907			Harvey, Thomas Featherstone, 84, Henry-road, West Bridgford, Nottingham
1894			Harvey, William Pellew, 62, London Wall, E.C.
1894			Hatfield, John Adams, F.I.C., c/o Messrs. J. Lysaght, Ltd., Orb Iron Works, Newport, Mon.
1892			Hatton, William Percy, c/o Messrs. W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred Edward, M.D. (Brussels), L.R.C.P. (Edin.), 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, Edward, D.Sc. (Vict.), Sunnyside, Norman-road, Runcorn, Cheshire
1898			Haworth, John, 17, Knaresboro'-road, Millhouses, Sheffield
1905	Trans.		Hawthorne, John, Municipal Technical Institute, Belfast
1907			Hay, William, Holton House, Beverley-road, Hull
1905			Hayman, Jack Vernon Johnson, A.C.G.I., A.I.C., Tringhurst, Cranleigh, Surrey
1900			Haynes, James Herbert, B.Sc. (Vict.), Sennen, 65, Kennington-avenue, Ashley Down, Bristol
1906			Hayworth, William Prince, A.I.C., 119, Clapton Common, N.E.
1903			Heasman, Harold Montague, 2, Broadway, Westminster, S.W.
1891			Heath, John William, 1, Carlyle-square, Chelsea, S.W.
1898			Heaton, John, Southcliffe, Roker, Sunderland
1902			Heaton, Noël, B.Sc. (Lond.), 20, Baker-road, Harlesden, N.W.
1906	Trans.		Hedley, Edgar Percy, A.R.C.S.I., 6, Royal-terrace-west, Kingstown, Co. Dublin
1899			Hedley, George Ward, M.A. (Oxon.), The College, Cheltenham
1905			Heely, Frederick William, 10, Yarborough-street, Grimsby

† Longstaff Medallist, 1906.

Date of Election.			
1876		C. 1895-9	Hehner, Otto, F.I.C., 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D. (Heidelberg), A.R.S.M., F.I.C., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, I.S.O., F.I.C., Simonstone, 27, Hammelton-road, Bromley, Kent
1896			Helps, James William, 3, Tavistock-road, Croydon
1899			Hembrough, James, A.R.C.S., A.I.C., 7, Park-view, Beeston-hill, Leeds
1900			Hemingway, Frank Christian Richard, 133, Front-street, New York City, U.S.A.
1898	Trans.		Hemmy, Arthur Stanley, Prof., B.A. (Cantab.), M.Sc. (Melbourne), Government College, Lahore, India
1885	Trans.		‖Henderson, George Gerald, Prof., M.A., D.Sc. (Glas.), F.I.C., The Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, Ph.D. (München), B.Sc. (St. Andrews), c/o Horlick's Malted Milk Co., Racine, Wisconsin, U.S.A.
1905			Henderson, James Alexander Russell, Prof., B.Sc. (Glas.), Chihli Provincial College, Paotingfu, North China
1900	Trans.		Henderson, John Brownlie, F.I.C., Government Analyst, Brisbane, Queensland
1892			Hendrick, James, B.Sc. (Lond.), F.I.C., Marischal College, Aberdeen
1903			Hendrickson, Arthur V., The Gas Works, Lower Sydenham, S.E.
1901			‖Henley, The Hon. Francis Robert, M.A. (Oxon.), F.I.C., 9, Beaufort-gardens, S.W.
1905			Hennings, Carl Richard, Ph.D. (Freiburg), 19, St. Dunstan's-hill, E.C.
1899	Trans.		Henry, Thomas Anderson, D.Sc. (Lond.), 70, Doneraile-street, Fulham, S.W.
1905	Trans.		Henstock, Herbert, M.Sc. (Vict.), Ph.D. (Zürich), 6, Elmet-avenue, Roundhay, Leeds
1904			Henzell, Archie Willoughby, Thomas Hanbury School, Shanghai, China
1895			Heriot, Thomas Hawkins Percy, 37, Church-crescent, Muswell Hill, N.
1871			Herman, Douglas, F.I.C., Rainhill, Lancs.
1876	Trans.	C. 1892-3	Heron, John, B.E. (R.U.I.), F.I.C., 110, Fenchurch-street, E.C.
1908			Heron, John Maxwell, North House, Mistley, Essex
1906			Herty, Charles Holmes, Prof., Ph.D. (Johns Hopkins Univ.), Ph.B. (Georgia), University of North Carolina, Chapel Hill, N.C., U.S.A.
1905			Hetherington, Arthur Lonsdale, B.A. (Cantab.), 3, Broadlands-road, Highgate, N.

Date of Election.			
1892	Trans.	C. 1903-05, 1908-	Hewitt, John Theodore, M.A. (Cantab.), D.Sc. (Lond.), Ph.D. (Heidelberg), 7, The Avenue, Surbiton, B.O., Surrey
1900			Hewitt, Samuel, 53, Dover-street, Unthank-road, Norwich
1892			Hewlett, John Cooke, 35–42, Charlotte-street, Great Eastern-street, E.C.
1883	Trans.	{C. 1897-1901}	‖Heycock, Charles Thomas, M.A. (Cantab.), F.R.S., 3, St. Peter's-terrace, Cambridge
1876	Trans.		Hibbert, Walter, F.I.C., 144, Walm-lane, Willesden Green, N.W.
1881			‖Hiddingh, Michael, Newlands, near Capetown, S. Africa
1905			Higgins, John Michael, 39, Queen-street, Melbourne, Australia
1907			Higham, Richard, 133, Mauldeth-road, Withington, Manchester
1908	Trans.		Hilditch, Thomas Percy, B.Sc. (Lond.), A.I.C., 4, Park-hall-place, East Finchley, N.
1882			‖Hill, Alexander, 4, Broad-street-place, E.C.
1896	Trans.		Hill, Arthur Croft, M.A., M.D. and B.S. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 169, Cromwell-road, S.W.
1906	Trans.		Hill, Arthur Edwin, c/o A. A. Hill, Esq., Constantinople
1896			‖Hill, Charles Alexander, B.Sc. (Lond.), F.I.C., 15, Brunswick-gardens, Kensington, W.
1896	Trans.		Hill, Ernest George, Prof., B.A. (Oxon.), Muir College, Allahabad, India
1905			Hill, William Basil, Eastfield, Stockton-lane, York
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, S.W.
1892			‖Hills, Harold Fletcher, Commercial Gas Works, Stepney, E.
1906			Hills, James Stuart, F.I.C., 225, Oxford-street, W.
1898			Hills, Thomas Herbert, St. Margaret's, Victoria-avenue, Westgate-on-Sea
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, John William, A.R.S.M., 55, Redcliffe-road, S.W.
1906			Hines, Charles Percy, B.Sc. (Lond.), The Grammar School, Dartford, Kent
1900			Hinks, Percy John, A.R.C.S., F.I.C., Woodstock, Beaconsfield-road, Blackheath, S.E.
1894			Hirsch, Charles Theodore William, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Charlinch, Rectory-road, Woolwich, S.E.
1870			Hislop, George Robertson, Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, Robert Findlay, Greenhill House, Paisley
1883			‖Hobbs, Bedo, Lamb Brewery, Chiswick, W.
1905			Hobsbaum, Isaac Berkwood, c/o Messrs. Lockett, Bros. & Co., Iquique, Chili, S. America
1901			Hobson, Edwin, Howdendyke, Howden, Yorks.

Date of Election.			
1882	Trans.		‖Hodgkin, John, F.I.C., 97, Hamlet-gardens-mansions Ravenscourt Park, W.
1879	Trans.	C. 1883-5, 1907-	Hodgkinson, William Richard Eaton, Prof., Ph.D. (Würzburg) F.I.C., 18, Glenluce-road, Blackheath, S.E.
1886			‖Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, Harry McAlpin, Brooklands, Greenmount, near Bury Lancs.
1873			‖Hodgson, Henry Tylston, M.A. (Cantab.), Harpenden, Herts.
1904			Hodgson, Thomas Reginald, B.A. (Cantab.), A.I.C., Analytica Department, School of Brewing, The University, Birminghan
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square W.
1883			Hogg, W. Douglas, M.D. (Paris), 62, Champs Elysées, Paris
1904			Hoit, Alfred Henry, 4, Montgomerie-road, Southsea
1876			Holcroft, Harold, M.A. (Cantab.), Parkdale, Wolverhampton
1902			Holdcroft, George Frederick, c/o The Hull Oil Manufacturing Co. Ltd., Stoneferry, Hull
1908			Holden, George Edward, 23, Durnford-street, Middleton Manchester
1885			Holgate, Thomas, 5, Victoria-street, Westminster, S.W.
1908			Holland, Frank William Crossley-, Connaught Club, Connaugh House, Marble Arch, W.
1908			Holland, Norman, 4907, Sherbrooke-street-west, Montreal, Canad
1876			Holland, Philip, F.I.C., 22, Taviton-street, Gordon-square W.C.
1902			Hollingworth, David Vincent, Gas Offices, Bloom-street, Salford
1905			Hollins, Cecil, 13, Clifton-road, Brockley, S.E.
1891			Holloman, Frederick Richard, Liston-street, Plaistow, E.
1886			Holloway, George Thomas, A.R.C.S., F.I.C., 57 and 58, Chancery lane, W.C.
1895			Holme, Arthur Edward, M.A. (Oxon.), The Wheelwright Gramma School, Dewsbury
1897	Trans.		Holmes, John, Government Laboratory, Clement's Inn Passage W.C.
1898	Trans.		Holroyd, George William Fraser, B.A. (Oxon.), Southampto House, Southwick, near Brighton
1902	Trans.		‖Holt, Alfred, jun., B.A. (Cantab.), Crofton, Aigburth, Liverpool
1893			Holthouse, Harold Bertram, 12, Melton-grove, West Bridgford Nottingham
1898			Homfray, David, B.Sc. (Lond.), F.I.C., The Ings, Misterton, near Gainsborough
1878			Hooker, Ayerst Henham, F.I.C., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel Cox, Ph.D., 4122, Chestnut-street, Phila delphia, U.S.A.

Date of Election.			
1883			‖Hooper, David, F.I.C., Economic and Art Section, Indian Museum, 1, Sudder-street, Calcutta, India
1888		C. 1907-08	‖Hooper, Egbert Grant, F.I.C., 16, Royal-avenue, Sloane-square, S.W.
1891			‖Hooper, Ernest Frederick, c/o Messrs. Brotherton & Co., Ltd., Wear Tar Works, South Dock, Sunderland
1907	Proc.		Hooton, William Marrs, M.A. (Oxon.) M.Sc. (L'pool), F.I.C., Repton School, Repton, Burton-on-Trent
1907			Hope, Geoffrey Dodleston, B.Sc. (Vict. and L'pool), Ph.D. (Halle), c/o Indian Tea Association, Calcutta, India
1906			Hopkins, Frederick Gowland, M.A. (Cantab.), M.B., D.Sc., and L.R.C.P. (Lond.), M.R.C.S. (Eng.), F.R.S., F.I.C., 55, St. Andrew's-street, Cambridge
1904			Horn, George Mathieson, Ivylands, Epping, Essex
1908			Hornby, Percy Hulme, 111, Nine Elms-lane, S.W.
1894			‖Hornby, Richard, M.A. (Oxon.), Haileybury College, Hertford
1908			Horrobin, Arthur, c/o Bombay, Baroda and Central India Railway Co., Ajmer, Rajputana, India
1904			Horrod, George William Thomas, 13, Lyric-road, Barnes, S.W.
1897			Horseman, James Walter, Elstow School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901	Proc.		Horton, Edward, 10, Smith-street, Chelsea, S.W.
1902			Hosking, Arthur Francis, c/o The Tasmania Gold Mining Co., Ltd., Beaconsfield, Tasmania
1886			‖Hoskins, Arthur Percy, F.I.C., Clonlee, Rosetta-park, Belfast
1907			Houghton, Edward, 35, Clarence-road, Chesterfield
1871			Houlder, William Washington, North Hyde House, Southall
1887	Proc.		Houlding, William, B.Sc. (Edin.), 34, Tynemouth-street, Liverpool
1896			Howard, Albert, The Agricultural Research Institute, Pusa, Bengal, India
1882			‖Howard, Alfred Gravely, Burnt House, Chigwell, Essex
1901			Howard, Bernard Farmborough, F.I.C., Quantocks, Woodford Green, Essex
1870		C. 1875-9, 83-5, 98-1902. V.P. 1886-9, 1903-06	‖Howard, David, J.P., F.I.C., Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, David Lloyd, Little Friday Hill, Chingford, Essex
1889			Howard, George William, Calverley, Tunbridge Wells
1875			Howard, Thomas, F.I.C., 50, Ellington-street, Liverpool-road, N.
1903			Howarth, John George, Danes Dyke, Chart-road, Reigate, Surrey

Date of Election.			
1882			Howe, James Lewis, Prof., M.D. (Louisville), Ph.D. (Göttingen), B.A. (Amherst), Washington and Lee University, Lexington, Va., U.S.A.
1880			Howell, Reginald, 95A, Southwark-street, S.E.
1905			Howgate, James Henry, B.A. (Lond.), The Grammar School, Huntingdon
1876			Howie, William Lamond, 26, Neville-court, Abbey-road, N.W.
1903			Howorth, Franklin Wise, 46, Lincoln's Inn Fields, W.C.
1889			‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889			Hoyles, Henry Richardson, 10, Fore-street, Wellington, Somerset
1907			Hoyten, William James, M.A., M.R.C.S. (Eng.), F.R.C.P., (Lond.), 37, Revelstoke-road, Wimbledon Park, S.W.
1907			‖Hubbard, The Hon. Raymond Egerton, Addington Manor, Winslow, Bucks.
1871			‖Hudleston, Wilfrid Hudleston, M.A. (Oxon.), F.R.S., 8, Stanhope-gardens, S.W.
1900			Hudson, Edmund Foster, M.A. (Cantab.), Churcher's College, Petersfield, Hants.
1878			Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899	Trans.		Hübner, Julius, M.Sc. (Manc.), F.I.C., Ash-villa, Cheadle Hulme, Cheshire
1903			Hughes, Edwin Reginald, 106, Queen Victoria-street, E.C.
1907			Hughes, Francis Townshend Cunynghame, Major, H.M.'s Assay Office, 47/1, Strand-road, Calcutta, India
1894	Trans.		Hughes, Frank, c/o Khedivial Agricultural Society, P.O. Box 63, Cairo, Egypt
1880	Trans.		Hughes, George Henry, 155, Fenchurch-street, E.C.
1868			Hughes, John, F.I.C., Analytical Laboratory, 79, Mark-lane, E.C.
1906			Hughes, John Gerard, 2, Canute-road, Southampton
1896			Hughes, Joshua Arthur, The Square, Abercarn, Mon.
1885			Hughes, Theophilus Vaughan, A.R.S.M., F.I.C., 4, George-road, Edgbaston, Birmingham
1882			Hughes, Thomas, F.I.C., Borough Analyst's Office, 31, Loudoun-square, Cardiff
1904			Hulme, John, 5, Duke-street, Macclesfield
1907			Humphries, Herbert Brooke Perren, B.Sc. (Lond.), A.R.C.S., 117, Avenell-road, Highbury, N.
1883			Humphrys, Norton Henry, 4, The Paragon, Wilton-road, Salisbury
1899			Hunter, Archibald Glen Kidston-, Public Analyst, Freemantle, W. Australia
1883			Hunter, John, F.I.C., 37, Chambers-street, Edinburgh

Date of Election.		
1885		Hunter, Matthew, M.A. (Oxon.), Rangoon College, Rangoon, Burma
1878		Huntington, Alfred Kirby, Prof., A.R.S.M., F.I.C., Metallurgical Laboratory, King's College, Strand, W.C.
1893	Trans.	Huntly, George Nevill, B.Sc. (Lond.), A.R.C.S., F.I.C., 96, Gower-street, W.C.
1902	Trans.	Hurtley, William Holdsworth, D.Sc. (Lond.), St. Bartholomew's Hospital, E.C.
1861		Huskisson, Henry Owen, F.I.C., 5, Gordon-square, W.C.
1907		Hussey, Arthur Vivian, A.C.G.I., c/o British Aluminium Co., Ltd., Foyers, N.B.
1900		Hutchin, Henry William, Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, M.A. (Cantab.), B.Sc., 3, Windsor-road, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A. (Cantab.), Ph.D. (Würzburg), Pembroke College, Cambridge
1884		‖Hutchinson, Christopher Clarke, F.I.C., 13, The Boltons, South Kensington, S.W.
1908		Hutchinson, Henry Brougham, Ph.D. (Göttingen), Ashby Villa, Devonshire-road, Harpenden, Herts.
1907		‖Hutchinson, William Doge, B.A. (Oxon.), Lythmore, Tennyson-road, Harpenden, Herts.
1901	Trans.	Hutton, Robert Salmon, D.Sc. (Vict.), West-street, Sheffield
1901		Hyder, Alfred James, B.Sc. (Lond.), Dinwoodie, Connaught-avenue, Chingford, Essex
1900		‖Ichioka, Tajiro, Prof., 19, Maruyama Shinmachi, Hongo, Tokio, Japan
1888		Idris, Thomas Howell Williams, M.P., 110, Pratt-street, Camden Town, N.W.
1907	Trans.	Ingham, Harry, M.Sc. (Vict.), 26, Hamilton-street, Bury, Lancs.
1889	Trans.	‖Ingle, Herbert, B.Sc. (Leeds), F.I.C., c/o Mrs. Roddis, 33, City-road, Edgbaston, Birmingham
1904	Trans.	Inglis, John Kenneth Harold, Prof., D.Sc. (Edin.), M.A., B.Sc. (N.Z.), University College, Reading
1901		Ingram, Beresford, Department of Agriculture and Technical Instruction, 17, Ely-place, Dublin
1897	Trans.	Innes, William Ross, D.Sc. (Vict.), Ph.D. (Heidelberg), F.I.C., 6, Griffiths-road, Wimbledon, S.W.
1901		‖Ionides, Stephen Archigenes, Rydene Croft, Walton-on-Thames
1906		‖Irving, Henry Carlyle, B.A. (Oxon.), 14, Heath Hurst-road, Hampstead, N.W.
1883		‖Irwin, Wilfred, Inglehurst, Higher-lane, Stand, Manchester

Date of Election.			
1892			‖Isaac, John F. V., M.A. (Oxon.), Barton Court, Abingdon, Berks.
1885			Ivatt, Albert, M.A. (Cantab.), The Engadine, Histon, Cambridge
1905			Jack, Maurice Brooks, Bedford Villa, 74, Park-avenue-south, Crouch End, N.
1894			Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex
1883			‖Jackson, Alfred Henrick, Prof., B.Sc. (Vict.), M.Inst.E.E., The Electrical Engineering School, 349, Collins-street, Melbourne, Australia
1894	Trans.		Jackson, David Hamilton, M.A. and B.Sc. (N.Z.), Ph.D. (Heidelberg), 95, Abbey-road, N.W.
1882			Jackson, Edward, F.I.C., Raven's Clift, Oxford-road, Moseley, Birmingham
1907			Jackson, Ernest Wilfrid, 3, Leven-street, Saltburn-by-the-Sea, Yorks.
1900	Trans.		Jackson, Henry, M.A. (Cantab.), Downing College, Cambridge
1884	Trans.		Jackson, Herbert, Prof., F.I.C., Chemical Laboratory, King's College, Strand, W.C.
1881			‖Jackson, Raynsford Valentine, M.A. (Oxon.), c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			‖Jackson, Samuel, A.R.C.S., F.I.C., c/o Messrs. Binny & Co., Ltd., Madras, India
1907			Jackson, Victor George, 21, Frankfurt-road Herne Hill, S.E.
1902			Jackson, William Brannan, Glengowan, Caldercruix, N.B.
1903			Jackson, William Henry, 73, Church-street, West Hartlepool
1887			‖Jadhava, Khasberao B., M.R.A.C., Nawasari, Bombay Presidency, India
1900			Jaffé, Adolf, 8, Leyburn-grove, Shipley, Yorks.
1878	Trans.		Jago, William, Barrister-at-Law, F.I.C., 3, Crown Office-row, Temple, E.C.; and 17, Wilbury-avenue, Hove, Sussex
1895			James, Alfred, 2, Broad-street-place, E.C.
1904	Trans.		James, Thomas Campbell, M.A. (Cantab.), B.Sc. (Wales), Edward Davies' Chemical Laboratories, University College of Wales, Aberystwyth
1904			James, Walter Richmond, 20, Parkdale, Wolverhampton
1878			Jamieson, Alexander, 2, Melrose-avenue, Cricklewood, N.W.
1901	Proc.		Jamieson, James Sprunt, F.I.C., Government Laboratory, Durban, Natal, S. Africa
1879	Trans.	C. 1882-5 F.S. 85-91 V.P. 95-9	†‖Japp, Francis Robert, Prof., M.A., Hon. LL.D. (St. Andrews), F.R.S., F.I.C., The University, Aberdeen

† Longstaff Medallist, 1891.

Date of Election.		
1902		Jardin, David Smith, A.R.C.S.I., F.I.C., Rathgar House, Rathgar, Co. Dublin
1902		Jardine, Douglas Kennedy, B.Sc. (Vict.), c/o Daily Chronicle Office, Georgetown, Demerara, British Guiana
1882		Jarmay, Gustav, F.I.C., Hartford Lodge, Hartford, Cheshire
1905		Jarrard, William John, B.Sc. (Lond.), A.R.C.S., The University, Sheffield
1898		Jee, Edwin Charles, D.Sc. (Lond.), F.I.C., 39, Pepys-road, New Cross, S.E.
1896	Proc.	Jeffers, Ernest Haynes, 87, Kyrle-road, West-side, Clapham Common, S.W.
1901	Proc.	Jemmett, William Henry Coutts, M.A. (Cantab.), Dagnall, Bakewell, Derbyshire
1891	Trans.	Jenkins, Henry Charles, A.R.S.M., Assoc. M.Inst.C.E., Balmoral, Green-lane, Redruth, Cornwall
1904		Jenkins, Herbert, 125, Hampton-road, Redland, Bristol
1892		‖Jenkins, John H. B., Chemical Laboratory, Great Eastern Railway Works, Stratford, E.
1906	Trans.	Jenkinson, Ernest Arthur, 4, Gloucester-place, Greenwich, S.E.
1894		Jenks, Robert Leonard, A.C.G.I., F.I.C., Central Excise Laboratory, Kasauli, Punjaub, India
1907		Jennings, John Atkinson, 34, Streatham-place, Brixton Hill, S.W.
1907		Jennings, Sidney James, B.Sc. (Lond.), 367, Queen's-road, New Cross, S.E.
1903		Jennings, Walter Ernest, 8, Rawdon-terrace, Ashby-de-la-Zouch
1894		Jennison, Francis Herbert, F.I.C., The Limes, Bitton, Bristol
1907		Jensen, Charles William Lamb, c/o Oakhill Brewery Co., Oakhill, near Bath
1897	Trans.	‖Jerdan, David Smiles, M.A. (Glas.), D.Sc. (Vict.), Ph.D. (Heidelberg), c/o Messrs. J. & G. Cox, Ltd., Gorgie Mills, Edinburgh
1898		Jessop, Samuel Morton, 19, Burton-street, Wakefield
1879		Jewson, Francis Albert Bowen, F.I.C., 24, York-road, Hove, Sussex
1901		Johnson, Charles Harold, M.D., C.M., F.R.C.S. and M.R.C.P. (Edin.), Beaumont, Northcote, Melbourne, Australia
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), 5 and 6, Fawkes-buildings, Great Tower-street, E.C.
1883		Johnson, James Edward, F.I.C., 40, Idmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1904		Johnson, John Richard, 10, Copley-park, Streatham Common, S.W.
1897		Johnson, Otis C., Prof., 730, Thayer-street, Ann Arbor, Mich., U.S.A.

Date of Election.		
1866		‖Johnson, Samuel Henry, The Warren-hill, Loughton, Essex
1906		Johnston, Archibald McArthur, Box 108, Germiston, Transvaal, S. Africa
1904		Johnston, John Haslam, M.Sc. (Vict.), F.I.C., Public Offices, Hampton, Middlesex
1896		Johnstone, James, F.I.C., Braehead, Parkhill, Rutherglen
1892		Johnstone, William George, c/o Thomas Manwell, Esq., 8, Great Winchester-street, E.C.
1901	Trans.	Jollyman, Walter Henry, F.I.C., c/o F. W. Jollyman, Esq., Charlton-road, Keynsham, Bristol
1903		Jones, Alfred Owen, The Hill, Scotby, near Carlisle
1907		Jones, Benjamin Owen, Boksburg, Transvaal, S. Africa
1905	Trans.	Jones, Bernard Mouat, B.A. (Oxon.), Prof., Government College, Lahore, India.
1898		Jones, Edward, B.Sc. (Lond.), F.I.C., 15, Macaulay-road, Clapham, S.W.
1906		Jones, Edward Rees, Llangedwyn Vicarage, Oswestry
1905		Jones, Edward Towyn, B.Sc., (Wales), A.I.C., 29, Somerset-road, Newport, Mon.
1871	Trans.	Jones, Edward William Taylor, F.I.C., The Oaklands, and 10, Victoria-street, Wolverhampton
1873	Trans.	Jones, Francis, M.Sc. (Manc.), F.R.S.E., Beaufort House, Alexandra-park, Manchester
1894		‖Jones, George Cecil, A.C.G.I., F.I.C., 43, Great Tower-street, E.C.
1893		Jones, Hedley Gordon, F.I.C., 32, Beechhill-road, Eltham, S.E.
1876	Trans.	‖Jones, Henry Chapman, F.I.C., Royal College of Science, South Kensington, S.W.
1878		Jones, Henry Williams, Spencer-park, Coventry
1900	Trans.	Jones, Humphrey Owen, M.A. (Cantab.), D.Sc. (Lond. and Wales), Clare College, Cambridge
1904		Jones, Horace Francis, Rose Bank, Cambridge-road, Uxbridge
1890		Jones, John Archyll, B.Sc. (Lond.), Reethville, Park-road, West Hartlepool
1901		Jones, John Lloyd Thomas, Lieut.-Col., I.M.S., M.B. (Dun.), M.R.C.S. (Eng.), D.P.H. (Cantab.), His Majesty's Assay Office, Calcutta, India
1892	Trans.	Jones, Lionel Manfred, B.Sc. (Lond.), Municipal Technical School, Suffolk-street, Birmingham
1899		Jones, Lauder William, A.B. (Williams Coll.), Ph.D. (Chicago), University of Chicago, Chicago, Ill., U.S.A.
1906		Jones, Llewelyn Thomas, B.Sc. (Wales), 22, Ashfield-terrace, Bingley, Yorks.
1891		Jones, Moses William, The Cottage, Brislington, Bristol

Date of Election.			
1905			Jones, Percy Walter, A.I.C., Toowong, Brisbane, Queensland
1896			Jones, Robert Haslewood, 88, Norwood-road, S.E.
1901			Jones, Robert Henry, M.Sc. (Vict.), The Harris Institute, Preston
1898			Jones, Thomas Hill-, Invicta Mills, Bow-common-lane, E.
1905			Jones, Tudor Foulkes, B.Sc. (Wales), Chatham House, Ramsgate
1904			Jones, William App., A.M. (North Carolina), Ph.D. (Baltimore), c/o The Boston Artificial Leather Co., Metropolitan Building, New York City, U.S.A.
1906			Jones, William Henry Matthews, Leyden Villa, Chester
1904	Trans.		Joseph, Alfred Francis, Prof., B.Sc. (Lond.), A.R.C.S., Ceylon Technical College, Colombo, Ceylon
1893	Trans.	C. 1906-	Jowett, Hooper Albert Dickinson, D.Sc. (Lond.), 5, Miskin-road, Dartford, Kent
1900			Joyce, Thomas Goode, B.Sc. (Lond.), F.I.C., Lyttleton Preserve and Drysaltery Works, Bromford-lane, West Bromwich
1893			Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.		Kawakita, Michitada, Engineering College, Tokio, Japan
1905	Trans.		Kay, Sydney Alexander, D.Sc. (St. Andrews), United College, St. Andrews, N.B.
1881	Trans.		Kay, William Edward, The Thorns, Prestwick-park, Manchester
1889			Kaye, James Robert, M.B. and C.M. (Glas.), D.P.H. (Cantab.), Medical Officer of Health, West Riding of Yorkshire, Wakefield
1907	Trans.		Kaye, John, M.A. and B.Sc. (Glas.), North Britain Glass Works, Perth, N.B.
1886	Trans.	C. 1903-5	‖Keane, Charles Alexander, Ph.D. (Erlangen), M.Sc. (Vict.), F.I.C., The Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1882			‖Keen, Austin, Hon. M.A. (Cantab.), Cefn Llys, Bentley-road, Cambridge
1894			‖Kellas, Alexander Mitchell, B.Sc. (Lond.), 2, St. Mark's-square, Regent's Park, N.W.; and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874			Kellner, William, Ph.D. (Göttingen), F.I.C., 135, Victoria-road, Old Charlton, S.O., Kent
1867			‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882			‖Kemp, William Joel, F.I.C., Caerthillian, Sidcup, S.O., Kent
1903			Kemp-Welch, Maurice, B.A. (Cantab.), Parkstone, Weybridge, Surrey
1884			Kendall, George Frederic, B.A. (Cantab.), The Hollies, Stratford-on-Avon
1874			Kendall, James Alfred, F.I.C., Lonesome Chemical Works, Streatham Common, S.W.

Date of Election.			
1896			‖Kennicott, Cass Langdon, Chicago Heights, Illinois, U.S.A.
1903			Kent, Thomas Oliver, 42, Loughboro'-park, Brixton, S.W.
1889			Kenwood, Henry Richard, M.B. and C.M. (Edin.), L.R.C.P. (Lond.), Wadhurst, 150, Bethune-road, Stamford Hill, N.
1895			Kenyon, Richard Ernest, M.Sc. (Vict.), c/o Mrs. Espey, Molesworth-street, Cookstown, Co. Tyrone, Ireland
1903			Kerr, James Stewart, A.R.C.S., F.I.C., Methodist College, Belfast
1883			Kerry, William Hugh Rubens, The Sycamores, Windermere
1900			Kershaw, James Henry, Corporation Sewage Works, Dalton, Rotherham, Yorks.
1901			Kettle, James David, B.Sc. (Lond.), A.I.C., 1, Vardens-road, St. John's-hill, Battersea, S.W.
1902			Kewley, James, B.A. (Cantab.), c/o Nederlandsch Indische, Industrié en Handel Maatschappij, Balek Pappin, Dutch Borneo
1901			Kiddell, Christopher George, B.A. (Lond.), Hadley Highstone, Barnet, Herts.
1903			Kielty, John Joseph, Nethersgate, Cairo-road, Walthamstow, Essex
1905			Killby, Leonard Gibbes, B.A. (Oxon.), 10, Aberdeen-park, Highbury, N.
1900			Kilner, George Washington, M.A. (Lond.), Ormefield, Long-lane, Church-end, Finchley, N.
1884			Kilpatrick, William Stirling, Hawklin, Stuart-drive, Colston, near Bishopbriggs
1903			Kin, Thein, B.A. (Calcutta), Chemical Examiner's Office, Rangoon, Lower Burma, India
1872	Trans.	C 1887-92	‖Kinch, Edward, Prof., F.I.C., Royal Agricultural College, Cirencester
1907			King, Albert Theodore, B.Sc. (Lond.), A.I.C., Chemical Department, The University, Leeds; and Church-hill, Horsell, Woking, Surrey
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1902			‖King, Frank Eustace, B.Sc. (Lond.), F.I.C., 75, Gracechurch-street, E.C.
1903			King, Frank William George, 15, Almond-road, Tottenham, N.
1897			King, Herbert, M.Sc. (Vict.), F.I.C., 8, Avenue-road, Scarborough
1908			King, James Kirkman, B.A. (Cantab.), 55, Brewery-road, Plumstead, Kent
1876			King, John Falconer, F.I.C., Laboratory of City Analyst, 20, Chambers-street, Edinburgh
1902			King, Sidney Isaac, Hazeldene, Avenue-road, Bexley Heath, Kent

Date of Election.			
1895			Kingdon, George Holman, M.A. (Oxon.), c/o Messrs. Crosfield, Limited, Warrington; and Ivy Lodge, Froghall, Warrington
1872	Trans.		‖Kingzett, Charles Thomas, F.I.C., Newlands, St. George's-avenue, Weybridge, Surrey
1895			‖Kinnicut, Leonard Parker, Prof., Sc.D. (Harvard), Worcester Polytechnic Institute, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6- V.P. 1908-	‖Kipping, Frederic Stanley, Prof., D.Sc. (Lond.), Ph.D. (Munich), F.R.S., F.I.C., University College, Nottingham
1886			Kirby, Herbert Edward, 41, Gordon-square, W.C.
1895			‖Kirkaldy, Patrick Henry, F.I.C., Chemical Department, King's College, W.C.
1903			Kirkby, William, Winster House, Thornfield-road, Heaton Moor, Stockport
1889			Kitchin, John, The Middlesex Hospital, W.C.
1888			‖Knaggs, Alfred Battye, 37, Mannville-terrace, Bradford
1889			Knight, Frederick Charles, c/o Garfield Smelting Co., Garfield, Utah, U.S.A.
1903			Knight, Harley Fancut, Ledbury, 64, Amhurst-park, Stamford Hill, N.
1894			Knight, James, M.A., D.Sc. (Glas.), St. James's Public School, Calton, Glasgow
1896			Knight, John Burnett, Bushwood, Wanstead, Essex
1894			Knight, William Albert, Sexey's Trade School, Bruton, Somerset
1878			Knights, James West, F.I.C., County Laboratory, Cambridge
1879			Knowles, Joshua, Stormer-hill, Tottington, Bury
1864			Knox, George Walter, B.Sc. (Lond.), 16, Finsbury-circus, E.C.
1873			Koch, Walter Edward, M.A., P.O. Box 718, El Paso, Texas, U.S.A.
1887	Trans.		Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1908			Kohn, Hugo Stefan, Ph.D. (Berlin), 3A, Hythe-road, Willesden Junction, N.W.
1904			Komppa, Gustav, Prof., Ph.D., Polytechnik, Helsingfors, Finland
1885			Koningh, Leonard de, F.I.C., 4, St. Martin's-road, Stockwell, S.W.
1892			Krause, Georg, Prof. Dr., Cöthen (Anhalt), Germany
1859	Trans.		Kynaston, Josiah Wyckliffe, F.I.C., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900			Kynaston, William Charles Robert, 9, Harland-road, Higher Tranmere, Birkenhead
1906			Ladell, William Richard Simpson, A.I.C., 19, Alwyne-road, N.
1893			Lamb, Edmund George, M.A. (Oxon.), M.P., Borden Wood, Liphook, Hants.

Date of Election.			
1900			Lamb, Morris Charles, Herold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.		‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893			Lambert, Wesley J., Chemical Laboratory, Royal Gun Factory, Woolwich, S.E.
1903	Proc.		Lamplough, Francis Edward Everard, B.A. (Cantab.), Trinity College, Cambridge
1877			Lancaster, William James, F.R.C.S., Pine Crest, Barnt Green, Worcs.
1902			Landau, A. Lionel, Taquah and Abosso Gold Mining Co., Ltd., Tarquah, Gold Coast, W. Africa
1900	Trans.		Lander, George Druce, D.Sc. (Lond. and St. Andrews), F.I.C., Royal Veterinary College, Camden Town, N.W.
1897	Trans.		Lang, William Robert, Prof., D.Sc. (Glas.), F.I.C., The University, Toronto, Canada
1899			Lange, Ernest Frederick Stephen, Fairholm, Willow Bank, Fallowfield, Manchester
1885			Langer, Charles, Ph.D. (Zürich), Ynyspenllwch, Clydach, S.O., Glamorgan
1891			‖Langham, Edgar Norman, Rev., M.A. (Cantab.), Rastrick Grammar School, Brighouse
1894	Trans.	C. 1904-7	Lapworth, Arthur, D.Sc. (Lond.), F.I.C., The Goldsmiths' Institute, New Cross, S.E.
1908			Larmuth, Lionel Gordon, Grove House, Cheadle Hulme, Manchester
1901	Proc.		Larter, Alfred Tabois, B.Sc. (Lond.), 86, Inderwick-road, N.
1883			Lascelles, Brian Piers, M.A. (Oxon.), Headland, Mount-park, Harrow-on-the-Hill
1880			Last, Frank Bernard, F.I.C., Granville House, Hinckley, Leicester
1901	Trans.		Lattey, Robert Tabor, Trinity College, Oxford
1906			Lattey, William Tabor, Corpus Christi College, Cambridge
1891	Trans.		Lauder, Alexander, D.Sc. (Edin.), Edinburgh and East of Scotland College of Agriculture, 13, George-square, Edinburgh
1904			Lauder, James Stanley, Contra Costa Co., c/o Post Office, Martinez, Cal., U.S.A.
1886	Trans.		Laurie, Arthur Pillans, Principal, M.A. (Cantab.), D.Sc. (Edin.), F.R.S.E., The Heriot-Watt College, Edinburgh
1876			‖Law, Channell, Ilsham Dene, Torquay
1905	Trans.		Law, Herbert Drake, B.Sc. (Lond.), Borough Polytechnic, 103, Borough-road, S.E.
1896			‖Law, Herbert Edward, 636, Pine-street, San Francisco, Cal., U.S.A.

Date of Election.		
1890	Trans.	‖Law, Robert, F.I.C., The Royal Mint, Melbourne, Australia
1903		Lawrence, Henry William, Johnsonville, Wellington, New Zealand
1900		Laws, Arthur Robert, B.Sc., (Lond.), 90, St. George's-terrace, Newcastle-on-Tyne
1882		Laws, Joseph Parry, F.I.C., 2, Aigburth-vale, Liverpool
1890	Trans.	‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890		Lea, Arthur Sheridan, M.A., Sc.D. (Cantab.), F.R.S., Sunnyside, Sidcup, S.O., Kent
1886		‖Leach, Walter, 21, St. Andrew's-place, Bradford
1902		Leader, George Herbert, Montego Bay Secondary School, Montego Bay, Jamaica
1894	Trans.	‖Lean, Bevan, B.A., D.Sc. (Lond.), Sidcot School, Winscombe, Somerset
1888		Lease, Frank Edward, Sapong Estate, Fort Birch, British North Borneo
1902		Leather, John Petty, Whittier, Colne-road, Burnley, Lancs.
1891	Trans.	Leather, John Walter, Ph.D. (Freiburg), F.I.C., Agricultural Research Institute, Pusa, Bengal, India
1900		‖Leathes, John Beresford, M.A., M.B. and B.Ch. (Oxon.), F.R.C.S. (Eng.), 89, Albert Bridge-road, S.W.
1889		Ledingham, Laurence Napier, Govandale, Taptonville-crescent, Sheffield
1883		Lee, Herbert Cabry, 22, Victoria-grove, W.
1898		Lee, Harry Lancelot, 32, Manor Drive, Headingley, Leeds
1897	Trans.	Lee, Theophilus Henry, 36, Rua do Ouvidor, Rio de Janeiro, Brazil
1905		Leek, William Henry, B.A. (Lond.), Elm View, Leigh, Lancs.
1899		Leeming, William Thomas, M.Sc. (Vict.), The Hollins, Hanover-road, Canterbury
1903	Trans.	Lees, Frederic Herbert, Avondale, Green-street-green-road, Dartford, Kent
1891		Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889		‖Legg, John Edmund, M.A. (Cantab.), F.I.C., Cae Rhys, Dorchester-road, Weymouth
1901		Lehmann, Adolf Ludwig Ferdinand, B.Sc. (Toronto), Ph.D. (Leipzig), Bangalore, Mysore, India
1891	Proc.	Leicester, James, Ph.D. (Erlangen), F.I.C., 17, Staverton-road, Oxford
1903		Leigh, Arthur Graham, jun., Chorcliff House, Chorley, Lancs.
1889		Leigh, Cecil, F.I.C., Birmingham Metal and Munitions Co., Ltd., Adderley Park Rolling Mills, Birmingham
1904		Le May, Percy Kent, 6, Lothair-villas, Hatfield, Herts.

Date of Election.			
1891			Lennox, Robert N., Morvah, Hartington-road, Chiswick, S.W.
1899			Leon, Arthur Alexander, Ray House, Ray-park-road, Maidenhead
1906	Trans.		Le Rossignol, Robert, B.Sc. (Lond.), A.I.C., 2, Caesarea-place, Jersey, Channel Islands
1904			Lessing, Rudolf, Ph.D. (Munich), Southampton House, 317, High Holborn, W.C.
1902			Lessner, Charles B., Carril, Spain
1895	Trans.	C. 1907-	‖Le Sueur, Henry Rondel, D.Sc. (Lond.), F.I.C., St. Thomas's Hospital, S.E.
1899			Lett, Stephen Joshua, Crosby Ravensworth, Shap, S.O., Westmoreland
1879			Letts, Edmund Albert, Prof., Hon. D.Sc. (R.U.I.), Ph.D. (Göttingen), F.I.C., Queen's College, Belfast
1904			Levy, Arthur Garfield, B.Sc. (Lond.), F.I.C., c/o B. Blount, Esq., F.I.C., 76, York-street, Westminster, S.W.
1903			Levy, Henry Wolff, 423B, Little Collins-street, Melbourne, Australia
1888	Trans.		Lewes, Vivian Byam, Prof., F.I.C., 30, Croom's-hill, Greenwich, S.E.
1907			Lewis, Carl, P.O. Box 36, Johannesburg, S. Africa
1899	Trans.		Lewis, Edward Watkin, Hollycroft, Loughton, Essex
1901			Lewis, Ernest Alfred, 310, Dudley-road, Birmingham
1905			Lewis, Ernest Isaac, B.A. (Cantab.), B.Sc. (Lond.), Oundle School, Oundle
1894	Trans.		Lewis, William Henry, M.A. (Oxon.), F.I.C., 24, Wonford-road, Exeter
1869	Trans.		‖Lewis, William James, Prof., M.A. (Oxon. and Cantab.), New Museums, Cambridge
1888	Trans.	C. 1902-03	‖Lewkowitsch, Julius, M.A. and Ph.D. (Breslau), F.I.C., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, Theodore David, F.I.C., Chemical Works, Silvertown, E.
1896			Lidgey, Cecil Rudolf, 50a, Forest Hill-road, East Dulwich, S.E.
1900			Liebmann, Adolf, M.A., Ph.D. (Bonn), 16, Darley-avenue, West Didsbury, Manchester
1903			Linday, John Howard, c/o Messrs. John Robinson and Co., Ltd., Oil Seed Crushers, Redcliffe-parade, Bristol
1901			Linde, Harold Theodor Granville van der, 101, Tyndall-avenue, Toronto, Canada
1899			Lindsey, Robert William, 14, Hilldrop-road, Camden-road, N.
1886	Trans.		Ling, Arthur Robert, F.I.C., 74, Great Tower-street, E.C.
1899			Linstead, Edward Flatman, 15, Station-avenue, Winchmore Hill, N.
1902			Liotard, Ernest, 2, Rue de France, Nice, France

Date of Election.			
1905			Lister, Joseph, B.Sc. (Lond.), A.R.C.S., Chemisches Laboratorium, (Parb I.), Liebigstrasse 18, Leipzig, Germany
1853	Trans.	V.P. 1883-7, 1898-1901.	‖Liveing, George Downing, Prof., M.A. (Cantab.), Hon. Sc.D. (Dub.), F.R.S., F.I.C., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof. M.A. (Cantab.), Hon. LL.D. (Glas.), A.R.S.M., F.R.S., F.I.C., United University Club, Suffolk-street, Pall Mall, S.W.
1903			Livesey, Charles Edwin Leonard, B.Sc. (Vict.), Stonyhurst College, Blackburn, Lancs.
1883			Livingston, William John, F.I.C., London County Council, Spring-gardens, S.W.
1880			‖Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.		Lloyd, Frederick James, F.I.C., Muscovy House, 6, Trinity-square, E.C.
1905			Lloyd, George Moss, M.A. (Vict.), M.Sc. (L'pool), 43, Elmwood-road, Herne Hill, S.E.
1907			Lloyd, Percival George, 15, Woodside-road, Kingston-on-Thames
1896			Lloyd, Thomas Henry, c/o Messrs. Quibell Bros., Ltd., Newark-on-Trent
1900			Lockhart, Thomas Lamb, Glencairn Main Reef Gold Mining Co., Ltd., P.O. Box 191, Germiston, Transvaal, S. Africa
1902			Lockitt, Charles Henry, B.A. (Lond.), Rectory Cottage, Solihull, Birmingham
1896			Lockwood, Thomas William, Heckmondwike, Yorks.
1871			Lockyer, William John, Bridgwater Lodge, Birchington, S.O., Kent
1902			Logan, Thomas Stratford, The Colony, Ewell, Surrey
1884			London, John Edward, M.D. (Dun.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 62, Main-street, Georgetown, Demerara, W. Indies
1872			‖Longstaff, George Blundell, M.A. and M.D. (Oxon.), F.R.C.P., (Lond.), M.R.C.S. (Eng.), Highlands, Putney Heath, S.W.
1904			Longstaff, James Patrick, B.Sc. (Edin.), 17, Fettes-row, Edinburgh
1873			‖Loram, Herbert Yabsley, F.I.C., 49, Buxton-road, Chingford, Essex
1878	Trans.		‖Louis, David Alexander, F.I.C., 77, Shirland-gardens, Maida Vale, W.
1882			Love, Edward Gurley, Ph.D. (Columbia), 80, East 55th-street, New York City, U.S.A.
1882			‖Lovibond, Thomas Watson, F.I.C., West Jesmond House, Newcastle-on-Tyne
1884			‖Low, Charles William, M.B. (Dun.), M.R.C.S. (Eng.), L.R.C.P. and D.P.H. (Lond.), Stricklands, Stowmarket, Suffolk

Date of Election.		
1904	Trans.	Lowe, Frank Harold, M.Sc. (Vict.), South-Western Polytechnic, Manresa-road, Chelsea, S.W.
1878		‖Lowe, Walter Bezant, M.A. (Cantab.), Cae Carw, Llanfairfechan, N. Wales
1876		Lowe, William Foulkes, A.R.S.M., F.I.C., 9, Hough-green, Chester
1898	Trans.	‖Lowry, Thomas Martin, D.Sc. (Lond.), 130, Horseferry-road, Westminster, S.W.
1901		Lowson, William, B.Sc. (Lond. and Leeds), F.I.C., The University, Leeds
1899		Lucas, Alfred, F.I.C., Survey Department, Finance Ministry, Giza, Egypt
1905		Lucas, Edward William, F.I.C., 2, Hills-place, Oxford-street, W.
1902		Lucas, Harry, The South of England College of Pharmacy, 186, Clapham-road, S.W.
1905		Luck, Alfred Courtenay, The Arsenal, Zarate, Argentine, S. America
1902	Trans.	Ludlam, Ernest Bowman, Ackworth School, near Pontefract, Yorks.
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, S. Africa ; and Southville, Swansea
1877	Trans.	‖Luff, Arthur Pearson, M.D., B.Sc., F.R.C.P. and L.S.A. (Lond.), M.R.C.S. (Eng.), D.P.H. (Glas.), F.I.C., 9, Queen Anne-street, Cavendish-square, W.
1890	Trans.	Lumsden, John Scott, D.Sc. (St. Andrews), Ph.D. (Munich), 9, Rosewood-terrace, West Park, Dundee
1907		Lunan, George, 50, Garscube-terrace, Murrayfield, Edinburgh
1867	Trans.	‖Lunge, Georg, Prof., Ph.D. (Breslau), Hon. Dr. Ing (Karlsruhe), Rämisstrasse 56, Zürich, Switzerland
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles Mann, D.Sc. (Lond.), F.I.C., Jumples Lodge, near Halifax, Yorks.
1899		Luxton, Thomas, B.A., B.Sc. (Lond.), 116, North Boulevard, Hull
1908		Lyell, Henry Robert, Redcot, Dacres-road, Sydenham, S.E.
1908		Lynch, Gerald Roche, 160, Holland-park-avenue, W.
1873		Lyon, Isidore Bernadotte, Brigade Surgeon, Lieut.-Col., C.I.E., M.R.C.S. (Eng.), F.I.C., East India U.S. Club, 16, St. James's-square, S.W. ; and 164, Sutherland-avenue, W.
1874		Lyon, John George, F.I.C., The Aire Tar Works, Knottingley, Yorks.
1905		Lyon, Rudolf, 400, Huddersfield-road, Halifax
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72, Brainard-street, Detroit, Mich., U.S.A.

Date of Election.		
1888		Maben, Thomas, Kenmure, 63, Stradella-road, Herne Hill, S.E.
1896		Macadam, Herbert Edwin, Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson John Charles George, F.I.C., Analytical Laboratory, 55, York-place, Edinburgh
1899		McAlley, James, Bankside Cottage, Falkirk, N.B.
1900		Macara, Thomas, F.I.C., c/o Messrs. Lipton's, Ltd., Rouel-road, Bermondsey, S.E.
1887		‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1890		‖MacArthur, John Stewart, 74, York-street, Glasgow
1888		McBretney, Edmund George, F.I.C., 23, Ferrybridge-road, Castleford, Yorks.
1900		McCall, William, 8, Beaton-road, Maxwell-park, Glasgow
1902		MacCallum, Douglas Archibald, Central-chambers, 93, Hope-street, Glasgow
1905		McCleary, William, 61, Station-road, Pendlebury, near Manchester
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1906		McCombie, Hamilton, M.A. (Aberd.), B.Sc. (Lond.), Ph.D. (Strassburg), A.R.C.S., F.I.C., The University, Birmingham
1907	Trans.	McConnan, James, D.Sc. (L'pool), M.Sc. (Vict.), Ph.D. (Jena), Frigorifico, Campana, F.C.R., Argentine, S. America
1904		McCourt, Cyril Douglas, A.C.G.I., 13, Malwood-road, Balham Hill, S.W.
1875		‖McCowan, William, F.I.C., Essex Wharf, Narrow-street, Limehouse, E.
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D. (Heidelberg), F.I.C., Government Laboratories, P.O. Box 1080, Johannesburg, S. Africa
1899		McCreath, William Dunlop, Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater
1890		‖McCubbin, William Alexander, F.I.C., May Cottage, Neston, Cheshire
1897		MacCulloch, Charles, Auckland Club, Auckland, New Zealand
1894		McCutcheon, James, Meniehaus, Woodend-drive, Jordanhill, Glasgow
1903		Macdonald, David Baird, 82, Hinckley-road, Leicester
1901		Macdonald, F. G., Durban Roodeport Gold Mining Co., Ltd., P.O. Box 111, Roodeport, Transvaal, S. Africa
1894	Trans.	MacDonald, George William, M.Sc. (Melbourne), c/o Messrs. Curtiss & Harvey, Ltd., Dartford, Kent
1901		Macdonald, Peter, c/o The Mazapil Copper Co., Ltd., Concepcion del Oro, Zacatecas, Mexico

Date of Election.			
1906			Macdonald, Thomas, c/o Indian Fisheries Co., Cochin, Southern India
1891			MacDonald, William, A.R.C.S., A.R.S.M., F.I.C., Assistant Postal Secretary, Peking, China
1904			McDougall, Arthur Thomas, B.A. (Lond.), 8, Cliff-terrace, St. John's, S.E.
1874			McDougall, John, Clifton House, Greenwich Park, S.E.
1906			McDowall, John, c/o H. Monson, Esq., Sabaieh, Upper Egypt
1906			Mace, William, Kew-gardens, Monkseaton, Northumberland
1886			MacEwan, Peter, 64, Southwood-lane, Highgate, N.
1898			McEwen, Antholl Francis, 40, Handen-road, Lee, S.E.
1895			MacFarlane, Alexander, Loch Sloy, Polefield, Blackley, Manchester
1891			Macfie, Robert Andrew Scott, M.A. (Cantab.), B.Sc. (Edin.), 34, Moorfields, Liverpool
1895			McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.		McGowan, George, Ph.D. (Leipzig), F.I.C., 21, Montpelier-road, Ealing, W.
1893			McGregory, Joseph Frank, Prof., Colgate University, Hamilton, N. Y., U.S.A.
1906			McIntosh, David, Stamford School, Stamford, Lincs.
1890			Macintyre, Alfred Edgar, Ph.D., The Chemical Laboratory, Dominion Arsenal, Quebec, Canada
1877			‖Mackay, Angus, 121, King-street, Great Yarmouth
1890			Mackean, William, 208, Bedford-hill, Balham, S.W.
1905			MacKechnie, Robert Drysdale, Productos Quimicos de Huelva Sociedad Anonyma, Huelva, Spain
1901	Trans.		McKenzie, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Berlin), Birkbeck College, Bream's Buildings, Chancery-lane, E.C.
1897	Trans.		Mackenzie, John Edwin, D.Sc. (Edin.), Ph.D. (Strassburg), 11, Ramsay-gardens, Edinburgh
1902			Mackenzie, John Ross, Worcester Brewery, Worcester
1899			Mackenzie, Thomas, 4, Church-street, Inverness
1900			Mackenzie, Thomas Ebenezer, The Capillitas Copper Co., Ltd., Pilciao, Provincia de Catamarca, Argentine, S. America
1893			McKerrow, Charles Alexander, Wingfield, Wilmslow, Cheshire
1892			McKerrow, William James, D.Sc. (Tübingen), F.I.C., 12, Chadwick-road, Leytonstone, N.E.
1897			Maclaurin, James Scott, D.Sc. (N.Z.), Wellington, New Zealand
1868	Trans.	C. 1871-4, 80-4, 95-9. V.P. 1887-90, 1901-04	‖McLeod, Herbert, Prof., F.R.S., 37, Montague-road, Richmond, Surrey
1899			McLeod, James, F.I.C., Gas Works, Kirkintilloch, N.B.

Date of Election.			
1903			MacMahon, Frederick William, 31, Marler-road, Forest Hill, S.E.
1879			‖Macmillan, James Laker, 98, Phillip-street, Sydney, N.S.W.
1897			Macmullen, Alan, B.A. (Oxon.), The Manor House, Raheny, S.O., Co. Dublin
1881			MacMunn, Charles Alexander, M.A. and M.D. (Dub.), L.R.C.S. (Ireland), Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, A.R.S.M., A.R.C.S., Mount-street, Nelson ; and c/o Maoriland Copper Co., Ltd., Richmond, Nelson, New Zealand
1880			Macnab, William, F.I.C., 10, Cromwell-crescent, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D. (Würzburg), B.Sc. (Lond.), 67, Braid-avenue, Edinburgh
1905			Maguire, Peter, 5, King's Bench-walk, Temple, E.C.
1899			Main, Hugh, B.Sc. (Lond.), Almondale, Buckingham-road, South Woodford, N.E.
1900			Mair, William, 7, Comiston-road, Edinburgh
1902	Trans.		Maitland, William, B.Sc. (Aberd.), Auchmill, Bucksburn, Aberdeenshire
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1906			Majumdar, Tarak Nath, 37, Lower Chitpore-road, Calcutta, India
1894			Makin, Charles James Shaw, F.I.C., Thorn Bank, Leamington
1885	Trans.		‖Mallet, Frederic Richard, F.I.C., 20, King's-avenue, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, John William, Prof., Ph.D. (Göttingen), M.D. (Louisiana), LL.D. (Princetown, Pennsylvania, and Johns Hopkins Univ.), F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, Willie Lee, Gawthorp-green, Kirkheaton, near Huddersfield
1904			Mander, Alfred, Berkswell, Malvern
1903			Mander, Percy George, B.Sc. (Lond.), The Grammar School, Doncaster
1903			Mann, Ernest William, Lyndale, Northfield-road, King's Norton, Birmingham
1903			Mann, John Christopher, Ash Villa, Thynne-street, West Bromwich
1902			Mann, William, B.Sc. (Lond.), 68, Breakspears-road, Brockley, S.E.
1896			Manners, Hugh, M.A., B.Sc. (Glas.), Academy House, Airdrie, N.B.
1908			Mansfield, Herbert, B.Sc. (Lond.), A.I.C., 70, Stapleton-hall-road, Stroud Green, N.
1897			Mansford, Charles John Jodrell, B.A. (Lond.), The Grammar School, Dartford, Kent

Date of Election.			
1895			‖Marchant, Robert Charles, The Glen, 11, Elliston-road, Redland, Bristol
1905	Trans.		Marle, Ernest Robert, B.Sc. (Lond.), A.R.C.S., Hartley University College, Southampton
1907	Trans.		Marsden, Herbert, B.Sc. (Manc.), Bramford, Ipswich
1895			Marsden, Prosper Henry, The Royal Infirmary, Liverpool
1902			Marsh, John, 29, High-street, Maidstone
1883	Trans.	C. 1902-7	‖Marsh, James Ernest, M.A. (Oxon.), F.R.S., University Museum, Oxford
1895	Trans.		Marshall, Arthur, F.I.C., 29, Charlton-road, Blackheath, S.E.
1907			Marshall, Hubert Frederick Sankey, c/o Messrs. Robert Stephenson & Son, Ltd., Burwell, Cambridge
1890	Trans.		Marshall, Hugh, Prof., D.Sc. (Edin.), F.R.S., University College, Dundee
1896			Marshall, Percy Sykes, Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, Kingscote, Upper Lenham-road, Sutton, Surrey.
1887			‖Marshall, William, F.I.C., Carisbrook, Queen's-road, Cheadle Hulme, Cheshire
1897			Martin, Charles Henry, 40, Bolton-road, Pendleton, Salford
1902			Martin, Francis, 3, York-terrace, Eglinton-road, Plumstead, S.E.
1905			Martin, Francis Grimshaw, 1, Harbury-road, Birmingham
1906			Martin, Frederick James, Akrokerri Mines, Ltd., Akrokerri, Gold Coast, W. Africa
1907			Martin, Gerald Hargrave, Hawkhurst, Auckland-road, Upper Norwood, S.E.
1906			Martin, George Frederick Wesley, 14, Castle-park, Lancaster
1898	Trans.		‖Martin, George Herbert, M.A. (Oxon.), 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Gerald Ward, Lieut.-Col., 8, Petersham-terrace, Gloucester-road, S.W.
1907			Martin, Joseph, B.Sc. (Dun.), 37, Fairlop-road, Leytonstone, E.
1901			Martin, Nicholas Henry, Ravenswood, Low Fell, Gateshead-on-Tyne
1902			Martindale, William Harrison, Ph.D., 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C.; and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Streatham-grove, Norwood, S.E.
1898			Mascarenhas, John Charles, 66, Wynndale-road, South Woodford, Essex
1851	Trans.	C. 1858-9, 75-7 V.P. 78-81	Maskelyne, Mervyn Herbert Nevil Story, M.A., Hon. D.Sc. (Oxon.), F.R.S., F.I.C., Salthrop, Wroughton, Wilts.

Date of Election.			
1905			Mason, Arthur Walter, B.Sc. (Lond.), Norvic, Windsor-gardens, North Shields
1890			Mason, Francis Herbert, P.O. Box 31, Paso Robles, Cal., U.S.A.
1882	Trans.		Masson, David Orme, Prof., M.A. and D.Sc. (Edin.), F.R.S., The University, Melbourne, Australia
1897			Masters, Edward, Rock Mount, 186, Hinckley-road, Leicester
1873			‖Masters, William, St. Erme, The Hall-road, Cheltenham
1906			Mastin, John, Woodleigh House, Totley Brook, near Sheffield
1904			Mathews, Harold Joseph Clarke, Massey's Burnley Brewery, Ltd., Burnley, Lancs.
1896			Mathieson, Laurence Weir, Conway, Rosebery-road, Gillingham, S.O., Kent
1902			Mathieson, Robert, J.P., Rill Bank, Innerleithen, Peeblesshire
1876	Trans.		‖Matthews, Charles George, F.I.C., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1907			Matthews, Charles Pask, B.Sc. (Lond.), A.I.C., 6, Fortess-road, N.W.
1880	Trans.	C. 1906-	‖Matthews, Francis Edward, Ph.D. (Göttingen), F.I.C., 6, Hill-croft-crescent, Ealing, W.
1884			‖Matthey, Edward, Col., C.B., A.R.S.M., 31a, Weymouth-street, W.
1870		C. 1877-9	Matthey, George, Assoc.Inst.C.E., F.R.S., 78, Hatton-garden, E.C.
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. (Cantab.), F.R.C.S. (Edin.), B.Sc. (Lond.), 29, Woolwich Common, S.E.
1908			Maywald, Frederick John, 89, Pine-street, New York City, U.S.A.
1892			Meacham, Charles Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, S. Africa
1908			Meade, Alwyne Harcourt, Cedar House, St. Neots
1898			Meads, Charles James, Plesaunce, West-cliff-road, Roker, Sunderland
1904			Mears, Francis D'Oyley, jun., 31, Rawdon-place, Cardiff
1901	Trans.		Mees, Charles Edward Kenneth, D.Sc. (Lond.), 76, Canterbury-road, Croydon
1908			Meggitt, Alfred Ash, B.Sc. (Lond.), Government of Eastern Bengal and Assam, Dacca, Eastern Bengal, India
1896			Meggitt, Loxley, F.I.C., c/o C.W.S., Ltd., Wheatsheaf Works, Alexandria, Sydney, N.S.W.
1871	Trans.	C. 1883-7, 90-91 F.S. 1891-1902 V.P. 1902–05 P. 1905-7	‖Meldola, Raphael, Prof., F.R.S., F.I.C., Finsbury Technical College, Leonard-street, E.C.; and 6, Brunswick-square, W.C.

Date of Election.			
1905	Trans.		Meldrum, Andrew Norman, D.Sc. (Aberd.), Chemical Department, The University, Manchester
1894			Melland, Godfrey, M.Sc. (Vict.), A.R.S.M., F.I.C., Chemical Department, The Polytechnic, Woolwich, S.E.
1908			Melling, Samuel Ernest, F.I.C., The Cliff, Higher Broughton, Manchester
1902	Trans.		Mellor, Joseph William, D.Sc. (N.Z.), The Villas, Stoke-on-Trent
1875			‖Melmore, Pattinson Banks, Chemical Laboratory, Maryport
1902			Mence, George Augustus Henry, B.Sc., The Grammar School, Lincoln
1900	Proc.		Menzies, Alan Wilfrid Cranbrook, M.A. and B.Sc. (Edin.), Kent Chemical Laboratory, The University, Chicago, Ill., U.S.A.
1889			Mercer, Thomas, F.I.C., Devonshire Club, Eastbourne
1901			Meredith, William, 63, Albion-place, Ulverston, Lancs.
1896			Merrett, William Henry, A.R.S.M., F.I.C., Hatherley, Grosvenor-road, Wallington, Surrey
1908			Merrick, Arnold, 66, Rothbury-terrace, Newcastle-on-Tyne
1891			Merrils, Frederick Johnson, 13, Rutland-park, Sheffield
1897			Merson, George Fowlie, 7, King-street, Kilmarnock, N.B.
1876	Trans.	C. 1884-8, 1897-1901 V.P. 1906-	‖Messel, Rudolph, Ph.D. (Tübingen), 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans, Ph.D., 1, Salmgasse, Prague, Bohemia
1904			Middleditch, Bernard, B.A. (Cantab.), Woodcroft, Harrow-on-the-Hill
1906			Middleton, Alexander Edmund, 112, South-park-road, Wimbledon, S.W.
1888	Trans.	V.P. 1901-04	‖Miers, Henry Alexander, Principal, M.A., D.Sc. (Oxon.), F.R.S., 23, Wetherby-gardens, S.W.
1904			Millar, Ernest Westby, Windsor, Monkstown, Co. Dublin
1892	Trans.		Millar, James Hill, F.I.C., 2, Kerrymount-avenue, Foxrock, Co. Dublin
1891			‖Millard, Edgar James, 35–42, Charlotte-street, Great Eastern-street, E.C.
1905			Millen, John Dunlop, Mount Bischoff Mine, Waratah, Tasmania
1880	Trans.		‖Miller, Alexander Kenneth, Ph.D. (Würzburg), F.I.C., Kilvert's-buildings, Withy-grove, Manchester
1901			Miller, Edward Holl, c/o Anglo Australian Milk Co., Clydebank, Sale, Victoria, Australia
1889			Miller, Harry East, Ph.D. (Strassburg), 1015, Chestnut-street, Oakland, California, U.S.A.

Date of Election.			
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc. (Illinois), Ph.D. (Berlin), 44 & 45, Lewis Block, Buffalo, N.Y., U.S.A.
1885	Trans.		‖Miller, Norman Harry John, Ph.D. (Würzburg), F.I.C., Harpenden, Herts.
1898			Miller, William Lash, B.A. (Toronto), Ph.D. (Munich), 50, St. Alban-street, Toronto, Canada
1896			Miller, William Murray, Caledonia Estate, Province Wellesley, Penang, Straits Settlements
1893	Trans.		‖Mills, Charles, F.I.C., P.O. Box 112, Kroonstad, S. Africa
1862	Trans.	C. 1868-72, 75-6, 80-4, 1903-06	‖Mills, Edmund James, Prof., D.Sc. (Lond.), LL.D. (Glas.), F.R.S., F.I.C., 64, Twyford-avenue, West Acton, W.
1906			Mills, Herbert Arthur, 3, Croxted-road, West Dulwich, S.E.
1898	Trans.		Mills, William Hobson, M.A. (Cantab.), Sc.D. (Tübingen), The Northern Polytechnic Institute, Holloway, N.
1905	Trans.		Mills, William Sloan, M.A., D.Sc. and B.E. (R.U.I.), Chemical Dept., The Polytechnic, Woolwich, S.E.
1885			‖Milne, Alexander, Lieut.-Col. I.M.S., M.A., M.B. and M.Ch. (Aberd.), H.M.'s Mint, Bombay, India
1887			Mingaye, John Charles Henderson, F.I.C., Department of Mines, Assay Branch, Sydney, N.S.W.
1898			‖Mitchell, Albert Henry, B.Sc. (Lond.), F.I.C., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1907	Trans.		Mitchell, Herbert Victor, 26, Brookfield-avenue, Walthamstow, N.E.
1905			‖Modi, Edalji Manekji, D.Sc. (N. Carolina), LL.D. (Tennessee), Litt.D. (Providence, Ohio), Opposite Grant-road-station, Sleater-road, Bombay, India
1899			Mohr, Bernard, Ph.D. (Heidelberg), 69A, Parliament-hill, Hampstead, N.W.
1901	Trans.		Moir, James, M.A., D.Sc. (Aberd.), Chemical Laboratory, Mines Department, Winchester House, Johannesburg, S. Africa
1893			Mole, Herbert Bloome, The Croft, Shepton Mallet
1902			Molesworth, Francis Hylton, Jersey-road, Artarmon, Sydney, N.S.W.
1899			Molson, John Cavendish, M.D. (Chicago), L.R.C.P. (Lond.), 17, Vernon-terrace, Brighton
1899			Mond, Emile Schweich, 22, Hyde-park-square, W.
1872	Trans.	C. 1885-6 V.P. 87-90, 94-8	‖Mond, Ludwig, Hon. D.Sc. (Vict. and Oxon.), Hon. Ph.D. (Heidelberg), F.R.S., F.I.C., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A. (Cantab.), F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1879			‖Mondy, Edmund Felix, A.R.S.M., Dacca, 96, Huron-road, Balham, S.W.

Date of Election.			
1903	Trans.		Monier-Williams, Gordon Wickham, M.A. (Oxon.), Ph.D. (Freiburg), A.I.C., The Lammas, Esher, Surrey
1904			Montgomery, Jack Percival, Ph.D. (Virginia), A.M. (Clarksville), Agricultural College, Starkville, Miss., U.S.A.
1887	Trans.	C. 1899-1900 1905-8	‖Moody, Gerald Tattersall, D.Sc. (Lond.), F.I.C., Lorne House, North Dulwich, S.E.
1897			Moon, Philip George Gregory, Hillcroft, Alexandra-road, Upper Parkstone, Dorset
1892			‖Moor, Cresacre George, M.A. (Cantab.), F.I.C., Savoy House, 115, Strand, W.C.
1903			Moore, Alfred Ernest, B.A., B.Sc. (Lond.), Escuela Normal Regional, Corrientes, Argentine, S. America
1903			Moore, Arthur, 109, Elgin-road, Seven Kings, Essex
1905	Trans.		Moore, Charles Watson, M.Sc. (Vict.), Ph.D. (Munich), The Wellcome Chemical Research Laboratory, 6, King-street, Snow-hill, E.C.
1891			Moore, Frederick Herbert, 39, Lime-street, E.C.
1907			Moore, John Edward Langford, Walton Cottage, Loughboro'-park, S.W.
1902			Moore, Thomas Henry, c/o Messrs. Burroughs, Wellcome & Co., 45, Lafayette-street, New York, U.S.A.
1904	Trans.		Moore, Tom Sidney, M.A. (Oxon.), B.Sc. (Lond.), Magdalen College, Oxford
1908			Morewood, Capel Darcy, Ferndale, Frodingham, Doncaster
1895			Morgan, David James, M.A., M.D. and B.C. (Cantab.), D.P.H. (Lond.), Medical Officer of Health, Swansea
1897			Morgan, Frederick Filmer de, 19A, Firs Mansions, Fortis-green-road, Muswell Hill, N.
1898	Trans.		‖Morgan, Gilbert Thomas, D.Sc. (Lond.), A.R.C.S., F.I.C., Royal College of Science, South Kensington, S.W.; and 15, Fawcett-street, Redcliffe-gardens, S.W.
1888			‖Morgan, John James, F.I.C., The Laboratory, Messrs. Cammell, Laird and Co., Ltd., Workington, Cumberland
1900			Morgan, John Livingston Rutgers, Prof., A.M., Ph.D. (Leipzig), B.Sc., Columbia University, New York, U.S.A.
1880	Trans.		Moritz, Edward Ralph, Ph.D. (Göttingen), F.I.C., 45, Great Tower-street, E.C.
1879	Trans.	C.1887-90, 96-1900	‖Morley, Henry Forster, M.A., D.Sc. (Lond.), F.I.C., 5, Lyndhurst-road, South Hampstead, N.W.
1895	Trans.		‖Morrell, Robert Selby, M.A. (Cantab.), Ph.D. (Würzburg), c/o Messrs. Mander Bros., Wolverhampton; and South Bank, Compton, Wolverhampton
1892			Morris, Albert, B.A., B.Sc. (Lond.), Fern Bank, Ashton-under-Lyne
1906			Morris, Arthur Higgs, 72, Chorley-new-road, Bolton, Lancs.

Date of Election.			
1900			Morris, Edgar Ford, M.A. (Oxon.), c/o Cornbrook Chemical Co., Ltd., Newbridge Mills, Stockport, Cheshire
1905			Morris, Edwin, A.R.C.S., A.R.S.M., 12, Dragon-view, Harrogate
1905			Morris, Eric Haydn, 44, Rua Nova de Fransisco de Paula 4, Pampulha, Lisbon, Portugal
1891			Morris, Joseph, Ph.D., Fern Bank, 8, Boardman-street, Eccles, Manchester
1851			Morson, Thomas, c/o Messrs. T. Morson and Son, Chemical Works, Ponders End, N.
1905			Mortimer, Alfred, B.A. (Oxon.), The Grammar School, Eastbourne
1872			Morton, Edward Handfield, 88, Wigmore-street, W.
1893			Morton, Frederick, Chemical Works, Milnsbridge, Huddersfield
1890	Trans.		Mosenthal, Henry de, F.I.C., 220, Winchester-house, Old Broad-street, E.C.
1896			Moss, Francis Ambrose, Kalgurli Gold Mines, Ltd, Kalgoorlie, Western Australia
1871			‖Moss, Richard Jackson, F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, William Edward, 2, Windermere-terrace, Princes-park, Liverpool
1905			Motion, John, 52, Manhattan-avenue, New York City, U.S.A.
1886			‖Moul, Frank, F.I.C., Aldersgate Chemical Works, Southall
1884			‖Moyle, Robert Edward, M.A. (Oxon.), Heightley, Chudleigh, S. Devon
1902			Müller, Christian, 9, Baronsfield-road, East Twickenham, Middlesex
1859	Trans.	C. 1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D. (Göttingen), LL.D. (St. Andrews), F.R.S., 13, Park-square East, Regent's Park, N.W.
1871	Trans.	C. 1890-4	‖Muir, Matthew Moncrieff Pattison, M.A. (Cantab.), Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc. (Lond.), F.R.S., The Lodge, Shortlands, Kent
1906			Mukerjee, Ram Chandra, Prof., B.A., Maharaja's College, Jaipur, Rajputana, India
1907			Mummery, Charles Samuel, Christ's Hospital, West Horsham, Sussex
1906			Mummery, William Rest, A.I.C., c/o Hygienic Dairy Society, Ltd., Salisbury
1893	Proc.		Munby, Alan Edward, M.A. (Cantab.), Royal Societies' Club, St. James'-street, S.W.
1902			Mundey, Alfred Holley, 14, Wrottesley-road, Plumstead, Kent
1876	Trans.		Munro, John May Herbert, D.Sc. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 12, Grosvenor-place, Bath

Date of Election.		
1888		Munroe, Charles Edward, Prof., George Washington University, Washington, D.C., U.S.A.
1900		Munton, Frederick Thomas, The Oak House, Winsford, Cheshire
1907		Murgatroyd, Louis, 1, Carlton-drive, Heaton, Bradford
1901		Murphy, Albert John, 28, Great George-street, Leeds
1904		Murray, Benjamin Lindley, A.M. (Columbia), B.S. (Michigan), 19, University-place, New York, U.S.A.
1893		Murray, John Alan, B.Sc. (Edin.), 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894		Murray, John Moore, M.Sc. (Vict.), 11, Winmarleigh-street, Warrington
1906		Murray, Thomas Jenkins, M.Sc. (Birm.), Ph.D. (Leipzig), The University, Birmingham
1890	Trans.	‖Murray, Thomas Smith, D.Sc. (Edin.),1, Nelson-street, Dundee
1869		‖Muspratt, Edmund Knowles, Hon. LL.D. (L'pool), F.I.C., Seaforth Hall, near Liverpool
1873		‖Muspratt, Sidney Knowles, 9, Church-street, Flint, N. Wales
1896		Muter, Alexander Henry Mitchell, F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1870	Trans.	‖Muter, John, Ph.D. (Rostock), F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.	Myers, William Shields, M.Sc. (N.J.), 12–16, John-street, New York City, U.S.A.
1887		Nagel, David Henry, M.A. (Oxon.), Trinity College, Oxford
1903		Nairne, Urban Orlando Scotchburn, 7, Hawthorne-terrace, Ripple-road, Barking, Essex
1874		‖Napier, Arthur S., Prof., B.Sc., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinandstrasse, Berlin
1893		Napier, John Watson, Corporation Gas Works, Alloa, N.B.
1900	Trans.	Napper, Sidney Scrivener, A.C.G.I., A.I.C., c/o Messrs. S. Cortauld and Co., Ltd., Foleshill-road, Coventry
1898		Nash, Leonard Myddelton, F.I.C., 3, Princess-road, Finsbury Park, N.
1900		Naylor, Ernest Brooks, M.Sc. (Vict.), A.I.C., 73, Castle-street, Bolton
1906		Naylor, George, 5, Albert-terrace, Promenade, Blackpool
1891		Naylor, William, 3, Garstang-road, Fulwood-park, Preston
1878	Trans.	Naylor, William Arthur Harrison, F.I.C., 38, Southwark-street, S.E.
1899	Trans.	Neale, Harry Ainley, Mission Junction, British Columbia
1908		Neech, Herbert Richard, 20, Colegrave-street, Lincoln
1898		Neilson, Alexander MacGillivray, Umbilo Post Office, via Durban, Natal, S. Africa

Date of Election.		
1908	Trans.	Neogi, Punchānan, Prof., M.A. (Calcutta), Rajshahi College, Rajshahi, Eastern Bengal and Assam, India
1901		Neumann, Edgar David Maurice, M.A. (Oxon.), Ph.D. (Göttingen), A.I.C., 7 & 8, Idol-lane, E.C.
1878	Trans.	‖Nevile, Ralph Henry Christopher, Wellingore Hall, Lincoln
1871	Trans.	‖Nevill, Edmund Neville, F.R.S., F.I.C., Government Laboratory, Durban, Natal, S. Africa
1890	Trans.	Neville, Francis Henry, M.A. (Cantab.), F.R.S., Sidney College, Cambridge
1905	Trans.	Neville, Henry Allen Dugdale, B.Sc. (Lond.), A.I.C., County Technical Laboratories, Chelmsford
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, M.A. (Oxon.) Balliol College Laboratory, Oxford
1901		Newbould, Herbert Simpson, 15, York-road, Heaton Moor, near Stockport
1864		‖Newlands, Benjamin Edward Reina, F.I.C., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William Peter Reina, 10, Cricklade-avenue, Streatham Hill, S.W.
1889		Newsholme, George Thomas Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, George Samuel, F.I.C., Royal College of Science, South Kensington, S.W.
1906		Newton, Arthur Percival, B.Sc. (Lond.), Ashburton House, Addiscombe, Croydon
1895		Newton, Charles Butterworth, Whitehall-chambers, Carlisle
1883		Newton, William, Ph.D. (Zürich), F.I.C., 39, Mincing-lane, E.C.
1899	Trans.	Nicholls, William Walter Scott, B.Sc. (Lond.), 230, Brockley-road, Brockley, S.E.
1870	Trans.	‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., M.R.C.S. (Eng.), L.S.A. (Lond.), D.P.H. (Cantab.), F.I.C., 1, Huskisson-street, Liverpool
1889		Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892		Nickolls, John Bate, The Exchange, Malvern
1883	Trans.	Nicol, William Walker James, M.A., D.Sc. (Edin.), F.I.C., 15, Blacket-place, Edinburgh
1900		Nightingale, Thomas Marginson, B.Sc. (Vict.), 375, Bridgman-street, Bolton
1898		Nightscales, Thomas Arthur, 37, Jalland-street, Hull
1894		Nixon, Alfred, 7, Oak-road, Sale, Manchester
1869		Noble, Sir Andrew, Bart., K.C.B., D.C.L. (Dun.), F.R.S., Jesmond Dene House, Newcastle-on-Tyne

Date of Election.			
1903	Trans.		Norman, George Marshall, B.Sc. (Lond.), A.R.C.S., A.I.C., 120, Walmersley-road, Bury, Lancs.
1889			Norman, John Thomas, 23, Leadenhall-street, E.C.
1861			Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892			Norris, Charles James, 31, Airedale-avenue, Chiswick, W.
1897	Trans.		North, Barker, 22, Park-avenue, Great Horton, Bradford
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, Thomas Herbert, Prof., Ph.D. (Heidelberg), D.Sc. (Hamilton), c/o The John Crerar Library, Chicago, Ill., U.S.A.
1901			Nunn, Arthur William, 57, Crouch-street, Colchester
1907			Nuttall, Walter Harold, F.I.C., 55, Market-street, Watford, Herts.
1904			Oakden, William Edward, 2, Gledhow-terrace, South Kensington, S.W.
1893	Trans.		Oates, William Henry, Broomhall-park, Sheffield
1907			Oberländer, Otto, Ph.D. (Heidelberg), 29, Queen-street, E.C.
1903			O'Brien, Frederick, M.Sc. (L'pool.), 87, Dongola-road, Horfield, Bristol
1902			O'Connor, Sinnott Valentine, 14, Selskar-street, Wexford
1890			Oddy, Robert Walter, F.I.C., Waterhouse, Toad-lane, Rochdale
1873			‖Odling, Walter, F.I.C., c/o Messrs. Bass and Co., Burton-on-Trent
1848	Trans.	S. 1856-69 V.P. 1869-73 P. 1873-5	Odling, William, Prof., M.A. (Oxon.), M.B. and F.R.C.P. (Lond.), Hon. Ph.D. (Leyden), F.R.S., F.I.C., 15, Norham-gardens, Oxford
1905			‖O'Farrelly, Alfons, M.A. (R.U.I.), 65a, Upper Leeson-street, Dublin
1902			Ogilvie, Allan, Levendale, Frodingham-road, Scunthorpe, Doncaster
1908			‖Oko, Alfred William, B.A. and LL.M. (Cantab.), 32, Denmark-villas, Hove, Sussex
1908			Okell, Stanley Allen Warrington, 27, King's-road, Ealing, W.
1901			Oldershaw, William, Strelley, Nottingham
1904			Oldfield, Laurel Cecil Francis, 5, Pump-court, Temple, E.C.
1906			Oliver, Edgar Gale, M.A. (Cantab.), Chigwell School, Essex
1889			O'Mahony, Daniel John, Municipal-buildings, Cork
1901			Oram, Frank, Market-place, Romsey
1890	Trans.		Ormandy, William Reginald, c/o Crossfield's Soap Works, Warrington
1869			‖Orme, Temple A., University College School, Frognal, N.W. and 213, Uxbridge-road, W.
1906	Trans.		Ormerod, Ernest, M.Sc. (Vict.), Ph.D. (Bâle), The Oaklands, Rochdale, Lancs.

Date of Election.		
1872		‖Ormerod, Joseph Arderne, M.D. (Oxon.), M.R.C.S. (Eng.), F.R.C.P. (Lond.), The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887		‖Ormiston, Archibald R., Braeholm, Helensburgh; and 213, St. Vincent-street, Glasgow
1893		Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, N.S.W.
1881		Orr, John Bryson, Crossacres, Much Woolton, Liverpool
1897	Trans.	‖Orton, Kennedy Joseph Previté, Prof., M.A. (Cantab.), Ph.D. (Heidelberg), F.I.C., Llwyn Eithin, and University College of North Wales, Bangor
1881	Trans.	O'Shea, Lucius Trant, B.Sc., The Cottage, East Cosham, Hants.
1887		Ostersetzer, Julius, F.I.C., c/o Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1883	Trans.	O'Sullivan, James, F.I.C., High Bank, Burton-on-Trent
1899		O'Sullivan, John, 1649, Barclay-street, Vancouver City, British Columbia
1887		‖O'Sullivan, Patrick Thomas, M.D. and B.Ch. (R.U.I.), 20, South Mall, Cork
1891		Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888		Overbeck, Otto Christoph Joseph Gerhard Ludwig, Chantry House, Great Grimsby
1887		‖Overend, Frederick Lawrence, B.A. (Oxon.), 74, Rowley-street, Walsall
1906		Oxland, Charles Harold, B.Sc. (Manc.), The Grammar School, Wellingborough
1904		Page, William Davidge, 17, Surrey-street, Strand, W.C.
1884		‖Pallister, John William, B.Sc. (Lond.), 107, Waverley-road, Bradford
1888		Palmer, Henry John, Banff, Alberta, Canada
1899		Palmer, Thomas Henry, Amalfi, Longueville, Sydney, N.S.W.
1879		Palmer, Sir Walter, Bart., B.Sc. (Lond.), The College, Reading; and 50, Grosvenor-square, W.
1902		Panisset, Sydney Glyde Stephen, 16, Weston-road, Strood, Kent
1899	Trans.	Panting, Laurence Christopher, M.A., M.D. and B.Ch. (Oxon.), 45, Lemon-street, Truro
1900		Pardy, Alexander, Central Experiment Farm, Cedara, Natal, S. Africa
1898		Parker, Alfred James, Salisbury House, Frant-road, Croydon
1897		Parker, Charles Henry, 106, Tettenhall-road, Wolverhampton
1882		Parker, Joseph Richard, Avondale, 129, Kyverdale-road, Stoke Newington, N.

Date of Election.			
1894	Trans.		Parker, Matthew Archibald, Prof., B.Sc. (Glas.), University of Manitoba, Winnipeg, Canada
1882			‖Parker, Robert Henry, Ravenscar, Orchard-road, Blackheath, S.E.
1901			Parkes, Albert Edward, F.I.C., Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890			Parkes, Thomas, M.A. (Cantab.), 2, Gawber-road, Barnsley
1906			‖Parkin, John, M.A. (Cantab.), Blaithwaite, Carlisle
1865	Trans.		‖Parkinson, James, Queen's-chambers, Pirie-street, Adelaide, S. Australia
1893			‖Parrish, Samuel, B.Sc. (Lond.), 80, Grange-avenue, Chapeltown-road, Leeds
1892			Parry, Ernest John, B.Sc. (Lond.), F.I.C., Thanet House, 56A, Great Dover-street, S.E.
1903			Parry, William, B.Sc. (Lond.), Church Gate, Waterloo-park, Liverpool
1870			Patchett, Isaac, F.I.C., 59, Holyrood-terrace, Carlinghow, Batley
1894	Trans.		Paterson, David, F.R.S.E., Lea Bank, Rosslyn, Midlothian
1885	Trans.		Patterson, George, F.I.C., The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, Joseph William, 20, South-road, West Hartlepool, Durham
1870	Trans.		Patterson, Thomas Law, F.I.C., Maybank, Finnart-street, Greenock
1904	Trans.		Patterson, Thomas Stewart, B.Sc. (Lond.), Ph.D. (Heidelberg), Chemical Department, The University, Glasgow
1863	Trans.	{ V.P. 1891-4 }	Pattinson, John, F.I.C., 10, Dean-street, Newcastle-on-Tyne
1868	Trans.		‖Paul, Benjamin Horatio, Ph.D. (Giessen), Analytical Laboratory, 13, Fenchurch-street, E.C.; and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D. (Tübingen), F.I.C., Market Hall-chambers, King-street, Huddersfield
1901			Pay, Walter Herbert, Government Laboratory, Durban, Natal
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Mosley-street, Newcastle-on-Tyne
1893			Payne, George Frederick, M.D. (Atlanta), 60, Armstrong-street, Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley John, School of Technology, Whitworth-street, Manchester
1901			Peacock, Arthur, B.Sc. (Vict.), The Brebner Schools, Bloemfontein, S. Africa
1900			Pearce, Ernest Vivian, The Hollies, Hayle, Cornwall
1874			Pearce, William, M.P., Chemical Works, Bow Common, E.
1906			Pearse, Leonard Edward Beard, A.R.S.M. (Lond.), 79, Woodfield-road, Ealing, W.

Date of Election.			
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1902			Peck, John Wicliffe, 13, Springwell-avenue, Harlesden, N.W.
1894			Peden, John, Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.	V.P. 1907-	‖Pedler, Sir Alexander, Prof., C.I.E., F.R.S., F.I.C., 28, Stanhope-gardens, Queen's Gate, S.W.
1904			Pell, Alfred, 44, Cumballa-hill, Bombay, India
1886	Proc.		Pendlebury, William Henry, M.A. (Oxon.), Woodford House, Mountfield, Shrewsbury
1905			Penn, Francis Richard, A.R.C.S., 36, Edinbro'-road, Upper Armley, Leeds
1870			Penney, Mulgrave Daniel, 11, High-street, Hull
1895			Pennington, William Henry, Westgate, Longley-road, Worsley
1905			Pennycuick, Thomas, B.Sc. (Lond.), 6, Darley-drive, West Derby, Liverpool
1906			Pennymore, Percy George, Runswick, Dudley-road, Brierley Hill
1886			Pentecost, Stephen James, Alexandra-mount, Mapperley Hill, Nottingham
1884	Trans.	C. 1906-	Perkin, Arthur George, Prof., F.R.S., F.I.C., 8, Montpelier-terrace, Hyde-park, Leeds
1891	Trans.		‖Perkin, Frederick Mollwo, Ph.D. (Würzburg), Borough Polytechnic, Borough-road, S.E.
1884	Trans.	C. 1891-5 V.P. 1906-	†Perkin, William Henry, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., Fairview, Wilbraham-road, Fallowfield, Manchester
1906			Perkins, William Hughes, B.Sc. (Manc.), The University, Leeds
1890	Trans.		‖Perman, Edgar Philip, D.Sc. (Lond.), University College, Cardiff
1905			Perrott, Bert, 5, Gnoll-avenue, Neath, Glam.
1888			Perry, George Edward, 103, Stirling-road, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Mosley-street, Manchester
1902			Phelps, John, M.A. (Oxon.), The Royal Mint, E.; and Newcroft, Egmont-road, Sutton, Surrey
1881			Philip, Arnold, B.Sc. (Lond.), A.R.S.M., F.I.C., Chemical Laboratory, H.M. Dockyard, Portsmouth
1897	Trans.		Philip, James Charles, M.A. and D.Sc. (Aberd.), Ph.D. (Göttingen), Royal College of Science, South Kensington, S.W.
1887			Phillips, Arthur Gaved, A.R.S.M., F.I.C., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1904			Phillips, George Frederick Tyler, B.Sc. (Lond.), University College, Southampton
1897			Phillips, Harry Edward William, B.A. (Oxon.), The Laurels, Eynsham, Oxford
1882			Phillips, Henry Harcourt, Lynwood, Turton, Lancs.

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† Longstaff Medallist, 1900.

Date of Election.			
1902	Trans.		Phillips, Percy Philip, Ph.D. (Göttingen), Thomason Engineering College, Rurki, North West Province, India
1908			Phillips, Thomas Richard, 2, North-east-wing, Somerset House, W.C.
1900			Phillpotts, Geoffrey Surtees, B.A. (Cantab.), 82, James-street, Dublin
1905			Phipson, Percy Barker, c/o Messrs. J. Staples and Co., Ltd., Wellington, New Zealand
1897	Trans.		‖Pickard, Robert Howson, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), F.I.C., Municipal Technical School, Blackburn
1891			Pickering, Michael Samuel, B.Sc. (Lond.), 38, Price-street, Burslem
1878	Trans.	C.1886-7, 89-93, 1901-04.	‖Pickering, Spencer Percival Umfreville, M.A. (Oxon.), F.R.S., F.I.C., Harpenden, Herts.
1906	Trans.		Pickles, Samuel Shrowder, D.Sc. (Vict.), Imperial Institute, S.W.
1890	Trans.		‖Picton, Harold, B.Sc. (Lond.), Clacton College, Clacton-on-Sea
1894			Pike, Ernest Brooke, Grasmere, 515, Romford-road, Forest Gate, E.
1903			Pike, Henry George, 8, Eastbourne-avenue, Claremont-road, Bath
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D. (Göttingen), Sandhills, Salcombe, S.O., Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, Thomas William, 33, Grove-hill-road, Denmark Hill, S.E.
1904			Pinchbeck, Gerald, c/o Messrs. Hough, Hoseason & Co., Chemical Works, Holland-street, Pendleton, Manchester
1889			Ping, William, 14, Selsdon-road, Wanstead, N.E.
1908			Pingriff, George Neville, B.A. (Cantab.), Central Secondary School, Suffolk-street, Birmingham
1889			Pingstone, George Arthur, P.O. Box 445, Bulawayo, S. Africa
1904			Pinkerton, David John, Crichton Cottage, Grange-street, Motherwell, N.B.
1908			Pinnock, Douglas Robert, 31, The Gardens, East Dulwich, S.E.
1881			Pisani, Orestes Victoriano, 56, Cavendish-road, Balham, S.W.
1903	Trans.		Pitt, Arthur Ernest, 66, Abbott-road, Bromley, E.
1903			Pitt, Harold Russell, 21, Parkview-terrace, Welling
1882			‖Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, Frederick Williams, St. Nicholas' Buildings West, Newcastle-on-Tyne
1899			Pizey, James Henry, A.R.C.S., F.I.C., Bella Vista 19, Minas de Rio Tinto, Provincia de Huelva, Spain
1893			Platt, Charles, M.D., Ph.D., Hahnemann Medical College, Philadelphia, U.S.A.
1899	Trans.		‖Plimmer, Robert Henry Aders, D.Sc. (Lond.), 3, Hall-road, N.W.

Date of Election.			
1903			Plymen, George Horace Gladstone, 134, Melrose-avenue, Cricklewood, N.W.
1907			Pochin, Harold, B.A. (Cantab.), 233, High-street, Berkhamsted, Herts.
1888			Pollard, Frederick Ernest, F.I.C., 14, Old Hall-street, Hertford
1898	Trans.		Pollard, William, M.A. (Cantab.), D.Sc. (Tübingen), The Museum, Jermyn-street, S.W.
1903			‖Pollard, William Branch, B.A. (Cantab.), Survey Department, Finance Ministry, Giza, Egypt
1902			Pollitt, George Paton, B.Sc. (Vict.), Ph.D. (Bâle), Winnington, Northwich, Cheshire
1901			Pollitt, James Charles Tomlin, 7, Grosvenor-road, Handsworth, Birmingham
1896			Pollitt, Robert Barnabas, F.I.C., Dinamita, *via* Noé, Durango, Mexico
1894	Trans.		‖Pollok, James Holms, D.Sc. (Glas.), Royal College of Science, Stephen's-green, Dublin
1903			Pond, George Gilbert, Prof., M.A. and Ph.D. (Amherst), State College, Pennsylvania, U.S.A.
1890			Pond, James Alexander, Auckland, New Zealand
1899			Ponthieu, Georges, 25, St. Jean Baptiste, Montreal, Canada
1848			Pontifex, Edmund Alfred, M.Inst.C.E., 6, Cadogan-court-gardens, Cadogan-place, S.W.
1905			Pooler, Frederick John, B.Sc. (Birm.), P.O. Box 508, Kimberley, S. Africa
1898	Trans.		Pope, Thomas Henry, B.Sc. (Birm.), A.C.G.I., F.I.C., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	†‖Pope, William Jackson, Prof., M.Sc. (Manc.), F.R.S., F.C.G.I. F.I.C., Chemical Laboratories, The University, Cambridge
1906			Porritt, Benjamin Dawson, B.Sc. (Lond.), A.I.C., Holly Lodge, 33, South-park-hill-road, South Croydon
1903			Porter, Robert James, 11, Arlington-street, Hull
1884	Proc.		‖Porter, Thomas Cunningham, M.A. and D.Sc. (Oxon.), Upton-park, Slough ; and Eton College, Windsor
1904			Porter, Thomas Linton Daniel, B.Sc. (Lond.), 161, Downsell-road, Stratford New Town, E.
1883			Potter, Charles Edward, c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland Samuel, Eastbury, Uplands-park-avenue, Loughton, Essex
1896			Potts, Henry William, Hawkesbury Agricultural College, Richmond, N.S.W.

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† Longstaff Medallist, 1903.

Date of Election.			
1895			Powell, Harry James, 530, Lordship-lane, S.E.
1896	Trans.		Power, Frederick Belding, Ph.D. (Strassburg), Hon. LL.D. (Wisconsin), 6, King-street, Snow-hill, E.C.
1884			‖Power, Francis Reginald, The Royal Mint, Melbourne, Australia
1902			Powney, William Edmund Francis, 42, Hornsey-park-road, N.
1904	Trans.		Prentice, Bertram, Ph.D. (Munich), D.Sc. (Edin.), Royal Technical Institute, Salford
1902			Přibram, Richard, Hofrat Prof. Dr., Horlgasse 9, Vienna IX., Austria
1882			‖Price, Arthur Faraday, 2503, Broadway, San Francisco, Cal., U.S.A.
1899			Price, Robert Coleman, Prof., The Miller School, P.O., Albemarle Co., Va., U.S.A.
1901	Trans.		Price, Thomas Slater, D.Sc. (Lond. and Birm.), Ph.D. (Leipzig), F.I.C., Chemical Department, Municipal Technical College, Suffolk-street, Birmingham
1889			‖Priestley, Charles William, B.Sc. (Lond.), A.R.C.S., Richmond Lodge, Torquay
1871	Trans.		‖Procter, Henry Richardson, Prof., Hon. M.Sc. (Leeds), F.I.C., The University, Leeds; and Rowangarth, Ben Rhydding, viâ Leeds
1889	Trans.		Proctor, Charles, F.I.C., 43 D, London-road, Forest Hill, S.E.
1896	Proc.		Proude, James, c/o John Turner, Esq., Providence Soap and Oil Works, Halifax
1897			Pullar, Herbert Spindler, Pullar's Dye Works, Perth, N.B.
1882			‖Pullar, Rufus Daniell, Brahan, Perth, N.B.
1902			Puntan, Herbert Harding Cruikshank, Borough Analyst's Office, London-chambers, Durban, Natal, S. Africa
1875	Trans.	C. 1888-92 V.P. 1899-1902	Purdie, Thomas, Prof., Ph.D. (Würzburg), Hon. LL.D. (Aberd.), B.Sc. (Lond.), F.R.S., A.R.S.M., F.I.C., The University, St. Andrews, N.B.
1901	Trans.		Purvis, John Edward, M.A. (Cantab.), A.R.C.S.I., F.I.C., University Chemical Laboratory, Cambridge
1906			Pye, Thomas Ebenezer, Clovelly, Chichester, Sussex
1886			Pyke, Lazarus Simon Magnus, Assoc.M.Inst.C.E., M.Inst.E.E., 10, Westbourne-terrace, Hyde Park, W.
1905	Trans.		Pyman, Frank Lee, M.Sc. (Vict.), Ph.D. (Bâle), Carlee, Selborne-road, Sidcup, S.O., Kent
1905			Quant, Ernest, 2, Park-crescent, Torquay
1868			Quibell, Oliver, Shalem Lodge, Newark
1894			Quinn, Gerald Grattan, A.R.C.S., 6, Glenroyd, Spotland, Rochdale
1901			Radcliffe, Lionel Guy, 6, Alma-terrace, Old Trafford, Manchester
1902			Ralphs, Edwin, Queen's College, Hong Kong

Date of Election.			
1897			Ralston, William, B.Sc. (Lond.), F.I.C., 3, Windsor-terrace, Linthouse, Govan, Glasgow
1892	Trans.		‖Ramage, Hugh, M.A. (Cantab.), A.R.C.S.I., F.I.C., Ridgemont, Carrow-hill, Norwich
1873	Trans.	C. 1886-9 V.P. 92-5, 1897-1900 F.S. 1902-1907 P. 1907-	†‖Ramsay, Sir William, K.C.B., Ph.D. (Tübingen), Hon. LL.D. (Glas.), Hon. Sc.D. (Dub. and Cantab.), Hon. D.Sc. (Oxon., L'pool and Columbia), F.R.S., F.I.C., University College, W.C.; and 19, Chester-terrace, Regent's Park, N.W.
1901			Ramsden, William Cecil, 107, Moyne-road, Rathmines, Dublin
1902			Ramshaw, Walter, Beech Cottage, Shaftesbury, Dorset
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1905			Ratcliffe, William Henry, B.Sc. (Lond.), 154, Verdant-lane, Hither Green, S.E.
1906			Rawles, Walter Hansen, 81, Lewisham High-road, S.E.
1880			‖Rawson, Christopher, F.I.C., Battenberg-avenue, Leicester
1884	Trans.		‖Rawson, Sidney George, D.Sc. (Lond.), F.I.C., Battersea Polytechnic, Battersea, S.W.
1898			Ray, John Armstedt, jun., B.A. (Dub.), 15, Nassau-street, Dublin
1908			Ray, Haradhan, M.A. (Calcutta), 4, Jhamapooker-lane, Calcutta, India
1902	Trans.		Rây, Prafulla Chandra, Prof., Presidency College, Calcutta
1889	Trans.		‖Read, Arthur Avery, Prof., M.Met. (Sheffield), F.I.C., University College, and 3, Fitzalan-place, Cardiff
1895			Read, Edwin James, B.A. (Cantab.), F.I.C., Portland, Belmont-road, Westgate-on-Sea
1899	Trans.		Read, Harold McLean, 19, Baronsmead-road, Castlenau, Barnes, S.W.
1900			Readman, James Fraser, 8, Park-avenue, Glasgow
1908			Readwin, William, 6, Kirkfield-terrace, Morley, near Leeds
1890			Redding, Richard James, 29, Isla-road, Plumstead, Kent
1906			Redgrove, Herbert Stanley, 137-140, Tottenham-court-road, W.
1892			Redman, Henry Ramsden, 60, Nelson-road, Gillingham, Kent
1866		C. 1891-2	Redwood, Sir Boverton, Hon. D.Sc. (Ohio), F.R.S.E., F.I.C., 4, Bishopsgate-street-within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, Theophilus Horne, F.I.C., 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D. (Berne), 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrsthof, 19, South-park-hill-road, South Croydon

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† Longstaff Medallist, 1897.

Date of Election.			
1880			‖Regester, William, Lawn Lodge, Isleworth, Middlesex
1897			Reid, Alexander Ferguson, Edgemont, Nevada, U.S.A.
1893			Reid, Thomas Anderson, 11, St. Catherine's-road, Bootle, near Liverpool
1881			‖Reid, Walter Francis, F.I.C., Fieldside, Addlestone, Surrey
1907	Trans.		Remfry, Frederic George Percy, B.A. (Cantab.), D.Sc. (Geneva), 19, Summerhill-road, Dartford, Kent
1897			Remington, John Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1886			Remington, Joseph Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1879	Trans.		Rennie, Edward Henry, Prof., D.Sc. (Lond.), F.I.C., The University, Adelaide, S. Australia
1898	Proc.		Renwick, Frank Forster, Norland House, Avenue-road, Brentwood, Essex
1902	Trans.		Revis, Cecil, 77, King-street, Hammersmith, W.
1873	Trans.	V.P. 1881-4, 89-92, 97-1900. P. 1901-1903.	Reynolds, James Emerson, Prof., Hon. Sc.D. and Hon. M.D. (Dub.), M.R.C.P. (Ireland), L.R.C.P. and S. (Edin.), F.R.S., 29, Campden-hill-court, Kensington, W.
1898	Trans.		Reynolds, William Colebrook, B.Sc. (Lond.), Meersbrook, Essex-road, Dartford, Kent
1907			Rhodes, Percy Joseph, Bridge House, Church, Lancs.
1898	Trans.		Rich, Edward Milton, 18, Manor-road, Forest Hill, S.E.
1903			Rich, Stiles William George, c/o Messrs. Thomason Chater, Ltd., Stanley-street, South Brisbane, Queensland
1889			Richards, Duncan Taylor, 57, Osborne-avenue, Westoe-lane, South Shields
1889			‖Richards, Edgar, 60, Ayrault-street, Newport, Rhode Island, U.S.A.
1908			Richards, Francis Edward, B.Sc. (Lond.), A.R.C.S., County Secondary School, Redruth
1905			Richards, Frederick George, 21, Dutton-street, Manchester
1889			‖Richards, Percy Andrew Ellis, F.I.C., Thurn Lodge, Upper Richmond-road, Roehampton, S.W.; and Charing Cross Hospital Medical School, W.C.
1886			Richards, William, B.Sc. (Lond.), 58, Thrale-road, S.W.
1885	Trans.		‖Richardson, Arthur, The Central Hindu College, Benares, N.W.P., India
1888	Trans.		‖Richardson, Clifford, 30, Church-street, New York City, U.S.A.
1906			‖Richardson, Frederic Ion, B.A. (Cantab.), Wynna, Walpole-street, Kew, near Melbourne, Australia
1883			Richardson, Frederic William, F.I.C., Oak Lea, Menston, Leeds

Date of Election.			
1903			Richardson, Harold Ernest, B.A., B.Sc. (Lond.), 1, Penlee-view-terrace, Penzance, Cornwall
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert Naylor Bardsley, B.A. (Cantab.), 10, Friar-lane, Leicester
1866			Richardson, Joseph, Pansei View, Arran-avenue, Marsland-road, Sale, Manchester
1906			Richardson, Lawrence George, 14, Ash-grove, Horton, Bradford
1892			Richardson, Reginald Edensor Stanley, 10, Friar-lane, Leicester
1887	Trans.		Richmond, Henry Droop, F.I.C., 30, Woodfield-road, Ealing, W.
1894			Riddick, David Gibson, Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc. (Lond.), F.I.C., 28, Victoria-street, Westminster, S.W.
1882	Trans.		Ridsdale, Charles Henry, F.I.C., Ravenscroft, Roman-road, Linthorpe, Middlesbrough
1888			Rigby, John Samuel, 26, Bagot-street, Wavertree, Liverpool
1905			Rigby, Thomas, c/o Messrs. Crossley Bros., Ltd., Openshaw, Manchester
1898			Rigg, Gilbert, c/o The New Jersey Zinc Co., Palmerton, Carbon Co., Pa., U.S.A.
1851	Trans.	C. 1878-80	Riley, Edward, F.I.C., 14A, Finsbury-square, E.C.
1904			Riley, Louis John Eczekiel, F.I.C., 8, Newton-road, W.
1900			Riley, Walter Alfred, Hazeldene, College-road, Norwich
1893			Rintoul, William, F.I.C., Royal Gunpowder Factory, Waltham Abbey
1907			Rixon, Frederic William, M.Sc. (Vict.), Ph.D. (Giessen), 93, Cornwall-road, Bristol
1902			Roast, Harold James, 43, Rielle-street, Cote St. Paul, Quebec, Canada
1893			Robbins, James Henry, B.Sc., 4, Selborne-road, Ilford, Essex
1897			Roberts, Ernest Henry, 81, Cicada-road, Wandsworth, S.W.
1883			‖Roberts, Frederick George Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899			Roberts, James, jun., 43, Great Western-road, Glasgow
1876			Roberts, Martin Fenn, General Post Office, E.C. ; and Mabshill, Epsom
1889			Roberts, Richard Wightwick, c/o Messrs. Rowe & Pitman, 14, Austin Friars, E.C.
1894			Roberts, Thomas John, Ingleside, Park-road, Huyton, nr. Liverpool
1880			Roberts, William Brittain, Wilderspool House, Warrington, Lancs.
1894			Robertson, Archibald Blair, Struan, Giffnock, Glasgow
1904			Robertson, Franklin Ernest, Gloster House, Harders-road, Peckham, S.E.

Date of Election.			
1903			Robertson, Frederick Duncan Struan, The Hewan, Bearsden, Glasgow
1903	Trans.		Robertson, Philip Wilfred, M.A. (N.Z.), Chemisches Laboratorium (Saal 1), Liebig-strasse, Leipzig, Germany
1907	Trans.		Robertson, Robert, M.A. and D.Sc. (St. Andrews), F.I.C., Research Department, Royal Arsenal, Woolwich, S.E. ; and 29, Charlton-road, Blackheath, S.E.
1901	Trans.		Robertson, William, 21, Worfield-street, Battersea Park, S.W.
1889			Robins, Harry Hollis, c/o Messrs. Southwell and Co., Dockhead, S.E.
1903			Robinson, Archibald Louis, M.A. (Dub.), St. Maur, Palmerston-park, Dublin
1896			Robinson, Henry Fishwick, M.Sc. (Vict.), 2, Richmond-street, Droylsden-road, Newton Heath, Manchester
1882	Trans.		‖Robinson, Henry Haliburton, M.A. (Oxon.), F.I.C., 75, Finborough-road, West Brompton, S.W.
1895			Robinson, Herbert Lewin, The Plating Co., 10, Kirby-street, Hatton-garden, E.C.
1907			Robinson, John, Agricultural College, Aspatria, Cumberland
1906			Robinson, Reginald Ernest, B.A. (Cantab.), 144, Burdett-road, Bow, E.
1904			Rodger, Robert, 54, Rostrevor-road, S.W.
1898			Rofe, Henry John, M.A. (Oxon.), 8, Victoria-street, Westminster, S.W.
1883			Rogers, Arthur William, Tadcaster Tower Brewery Co., Tadcaster
1884			Rogers, Francis Murray, 21, Burma-road, Stoke Newington, N.
1905			Rogers, Harold Rudolf, M.A. (Oxon.), 19, King-street, Newcastle, Staffs.
1903			Rogers, William David, A.R.C.S., F.I.C., 36, Grange-road, Smethwick, B.O., Staffs.
1906	Trans.		Rogerson, Harold, M.Sc. (Manc.), 6, King-street, Snow Hill, E.C.
1894			Rolfe, John F., 50, South-street, Greenwich, S.E.
1903			Roose, Fitzroy Owen Jonathan, Assoc.Inst.E.E., 18, Vincent-square-mansions, Westminster, S.W.
1855	Trans.	C. 1860-4, 1871-3 V.P. 73-5, 1877-80 P. 80-2	Roscoe, Sir Henry Enfield, B.A., D.C.L., (Oxon.), LL.D. (Cantab., Dub., Glas., Montreal, Aberd.), Ph.D. and Hon. M.D. (Heidelberg), Hon. D.Sc. (Vict.), F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8.	‖Rose, Thomas Kirke, D.Sc. (Lond.), 6, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D. (Würzburg), 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, F.I.C., 1, Glengall-road, Old Kent-road, S.E.
1905			Ross, Frederick Wilson Montrose, 21, Soho-square, W.
1881			Ross, Henry, Rev., LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.

Date of Election.			
1896			Ross, Raymond St. George, F.I.C., Public Analyst's Office, Burnley
1902			Ross, William Charles, Capt., I.M.S., M.B., Ch.B. and D.P.H. (Edin.), Deputy Sanitary Commissioner, Bankipore, E.I.R., Bengal, India
1891	Proc.		Rossiter, Edmund Charles, F.I.C., 4, Park-road, West Smethwick, Birmingham
1896			Rostron, Harold, B.Sc. (Vict.), 699, Manchester-road, Bolton
1892			Rothwell, Charles Frederick Seymour, Beech Croft, Mobberley, Knutsford
1904			Rouillard, Marie Jean Louis Ernest, B.Sc. (Edin.), Malvern, Natal, S. Africa
1899			Roundell, Christopher Foulis, Lieut., B.A. (Oxon.), Guards' Club, Pall Mall, S.W.
1900			Row, Mysore Chavan Nanjunda, B.A., M.B. and C.M. (Madras), Mylapore, Madras, India
1905			Rowland, James Frederick Fothergill, B.A. (Cantab.), 18, Kingdon-road, West Hampstead, N.W.
1905			Rowley, Henry, M.Inst.E.E., 81, Barrack-street, Perth, Western Australia
1906			Rowsell, Philip Foale, Nutbrook, Exmouth, S. Devon
1900			Roy, Mathura Goolab, 74, Iyah Mudali-street, Chintadrepettah, Madras, India
1899			Royal-Dawson, Henry, c/o Messrs. Peyton and Son, Lister-street, Birmingham; and 6, Wimbourne-road, Edgbaston, Birmingham
1901			Royle, Charles Leonard, c/o Messrs. Parry and Co., Madras, India
1905			Royle, Harold Marmion, Store House, Gas Works, Beckton, North Woolwich
1872	Trans.		Ruffle, John, F.I.C., Musley, Ware, Herts.
1895			Rugginz, William Augustus, Sundridge, St. Alban's-crescent, Woodford Green, Essex
1889	Trans.	C. 1903-05	Ruhemann, Siegfried, M.A. (Cantab.), Ph.D. (Berlin), Gonville and Caius College, Cambridge
1883			Rumble, Charles, F.I.C., 9, Sangora-road, New Wandsworth, S.W.
1908			Runeckles, Arthur Robert, 68, Kyrle-road, New Wandsworth, S.W.
1890			‖Russell, Edward, B.Sc. (Lond.), F.I.C., 18, Woodstock-road, Redland-green, Bristol
1898	Trans.		Russell, Edward John, D.Sc. (Lond.), Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.
1901			Russell, James Bertram, B.Sc. (Lond.), Colyton, Hill-road, Weston-super-Mare

Date of Election.			
1851	Trans.	C. 1863-7, 1870-2 V.P. 1872-3 S. 1873-5 T. 1875-89 P. 1889-91	‖Russell, William James, Ph.D. (Heidelberg), F.R.S., F.I.C., 34, Upper Hamilton-terrace, St. John's Wood, N.W.
1908			Rutter, Clement Thomas, 4, Bath-terrace, Hanwell, W.
1896			Rutter, Thomas Francis, B.Sc. (Lond.), Ph.D. (Leipzig), Newcastle-under-Lyme
1894			Ryce, George, B.A. (R.U.I.), Irish Agricultural Offices of the Potash Syndicate, 50, Essex-street, Dublin
1901	Trans.		Ryffel, John Henry, M.A. (Cantab.), B.Sc. (Lond.), 10, Grasmere-road, Muswell Hill, N.
1888			‖Sach, Albert John, Technical College, Goulburn, N.S.W.
1868			Sadler, Sir Samuel Alexander, Col., Cleveland Chemical Works, Middlesbrough
1896			Sage, Charles Edward, c/o W. C. Nickels, Esq., 41, Cheapside, E.C.
1907			Sahni, Ruchi Ram, M.A., Government College, Lahore, India
1879	Trans.		‖Sakurai, Joji, Prof., Science College, Imperial University, Tokio, Japan
1880			Salamon, Alfred Gordon, A.R.S.M., F.I.C., 1, Fenchurch-avenue, E.C.
1906			Salmon, Frederick John, c/o Government Survey Department, Colombo, Ceylon
1876			‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and 49, Grosvenor-street, W.
1863			‖Salt, Henry, M.D. and C.M. (Edin.), Inglewood, Great Malvern
1871			‖Salter, Mortyn John, F.I.C., Greyrickhouse, Mickleton, S.O., Glos.
1859			‖Salter, Thomas William, 193, Priory-road, West-hill, Hastings
1907	Trans.		Salway, Arthur Henry, B.Sc. (Lond.), Ph.D. (Leipzig), 51, Goodmayes-avenue, Goodmayes, near Ilford, Essex
1902			Sampson, John William, Cleveland Pharmacy, Bath
1882			Samuel, William Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.
1898	Trans.		Sand, Henry Julius Salomon, Ph.D. (Zürich), D.Sc. (Birm.) University College, Nottingham
1870			‖Sandberg, Christer Peter, Palace-chambers, 9, Bridge-street, Westminster, S.W.
1900	Proc.		Sanders, James McConnell, c/o Direccion General de Aduanas, Mexico
1904			Sanders, Percy Richard, West Cliffe, Seaford, Sussex
1888			Sanderson, John, F.I.C., c/o Messrs. B. S. Cohen, Ltd., 15, Clerkenwell-close, E.C.

Date of Election.		
1901		Sandford, Thomas, 8, Market-street, Dalton-in-Furness
1882		Sanford, Percy Gerald, F.I.C., 14, Wellington-road, West Croydon
1890		Saniter, Ernest Henry, Strafford Villa, Moorgate, Rotherham
1891		Sanyal, Abhayacharan, Prof., M.A. (Calcutta), Queen's College, Benares, N.W.P., India
1906		Sanyal, Surendra Prasad, M.A. (Calcutta), The Rajbati, Majhauli Raj P.O., Gorakhpur District, U.P., India
1892		Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900		Sargeant, Fred Pilkington, College of Pharmacy, Clarendon-road, Leeds
1907		Saunders, George Joseph, B.E. (Sydney), School of Mines, Charters Towers, Queensland, Australia
1886		Saunders, William, Prof., Experimental Farm, Ottawa, Canada
1898		Sayer, Harold Charles, 51, Highfield-road, Dartford
1890		Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885		Scammell, Luther Robert, c/o Messrs. F. H. Faulding & Co., 54, King William-street, Adelaide, S. Australia
1877		Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897		Scargill, Lionel Walter Kennedy, M.A. (Oxon.), 10, Castle-hill, Cambridge
1893	Trans.	Schidrowitz, Philip, Ph.D. (Berne), 57, Chancery-lane, W.C.
1888		‖Schieffelin, William Jay, Ph.B. (Columbia), 840, Southern-boulevard, New York, U.S.A.
1907		Schlinger, Charles, B.Sc. (Lond.), Acadia House, 273, Camden-road, N.
1905		Schnurmann, Harry Nestor-, 22, Park-avenue, Willesden Green, N.W.
1907		Schober, William Bush, A.M. and B.Sc. (Annapolis), Ph.D. (Johns Hopkins), Lehigh University, South Bethlehem, Pa., U.S.A.
1892		‖Schofield, James Alexander, A.R.S.M., F.I.C., The University, Sydney, N.S.W.
1903		Scholefield, Alfred Henry, B.A. and B.Sc. (Lond.), 57, The Avenue, Leigh, Lancs.
1905	Trans.	Scholefield, Fred, M.Sc. (Vict.), B.Sc. (Lond. and Leeds), A.I.C., c/o Messrs. H. Ashwell & Co., Ltd., New Basford, Nottingham
1902		Scholes, William, Mount Sion, Radcliffe, Lancs.
1899	Trans.	Schryver, Samuel Barnett, D.Sc. (Lond.), Ph.D. (Leipzig), 27, Arundel-gardens, Notting Hill, W.
1896		Scotland, Peter Bain, c/o The Arizona Copper Co., Ltd., Metcalf Mines, Clifton, Arizona, U.S.A.

Date of Election.			
1879	Trans.	C. 1897-9 S. 1899-1904 T. 1904-	‖Scott, Alexander, M.A. and Sc.D. (Cantab.), D.Sc. (Edin.), F.R.S., F.I.C., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.; and 13, Neville-court, Abbey-road, N.W.
1908			Scott, Andrew Laidlaw, F.I.C., Royal Gunpowder Factory, Waltham Abbey, Essex
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, George Charlton, c/o Messrs. Burn & Co., Ltd., Raneegunge, Bengal, India
1905			Scott, John Irwin, M.A. (Oxon.), Deacon's School, Peterborough
1906			Scouller, Walter Daly, B.Sc. (Vict.), Chester Corporation Sewage Purification Works, Chester
1883	Proc.		Scudder, Frank, F.I.C., 44, Mosley-street, Manchester
1906			Seaber, Willie Macro, B.Sc. (Lond.), A.I.C., Firdale, Sheen-lane, East Sheen, S.W.
1896			Seabrooke, Herbert Cecil, F.I.C., Black Ash, Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup, S.O., Kent
1890			Seaton, Edward Cox, M.D. and F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., 93, St. George's-square, S.W.
1905			Seaton, William Dunham, 40, Argyle-road, Ilford, Essex
1908			Seelhorst, William, c/o Eastern Smelting Co., Ltd., Penang, Straits Settlements
1898			Seligman, Richard, Ph.D. (Heidelberg), A.C.G.I., 109, Queen Victoria-street, E.C.
1892	Trans.	C. 1905-	Sell, William James, M.A., Sc.D., (Cantab.), F.R.S., F.I.C., University Chemical Laboratory, Pembroke-street, Cambridge
1875			Sellon, John Scudamore, 78, Hatton-garden, E.C.
1906			Sen, Gopal Chandra, M.A. (Calcutta), 210, Cornwallis-street, Calcutta, India
1904	Trans.		Sen, Jatindranâth, M.A. (Calcutta), Agricultural Research Institute, Pusa, Bengal, India
1875	Trans.		‖Senier, Alfred, Prof., M.D. (Mich.), Ph.D. (Berlin), F.I.C., Queen's College, and Gurthard, Galway, Ireland
1887			Senier, Harold, F.I.C., Hanley House, Ryde, Isle of Wight
1906			Senior, John, c/o Messrs. Hargreaves, Bros. and Co., Ltd., Starch, Blue and Blacklead Works, Hull
1903	Trans.		Senter, George, Ph.D. (Leipzig), B.Sc. (Lond.), Chemical Laboratory, St. Mary's Hospital Medical School, Paddington, W.
1905			Setterington, Douglas Temple, 133, Warbreck-road, Blackpool, Lancs.
1896			Severn, Walter Dalrymple, A.R.C.S., Public Health Laboratory, Cape Town, S. Africa
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.

Date of Election.		
1907		Sewell, William George, B.Sc. (Lond.), Bournemouth School, Bournemouth
1874		‖Sexton, Alexander Humboldt, Prof., F.I.C., F.R.S.E., Glasgow and West of Scotland Technical College, 204, George-street, Glasgow
1895		Seyler, Clarence Arthur, B.Sc. (Lond.), F.I.C., The Technical Institute, Nelson-terrace, Swansea
1904		Shacklady, Thomas George, c/o British Turpentine Corporation, Ltd., Hayes, Middlesex
1880		Shadwell, John Emilius Lancelot, F.I.C., Milton House, Bathwick-hill, Bath
1874		Sharman, William, 186, Mare-street, Hackney, N.E.
1885		Sharp, James, Shirley Manor, Wyke, near Bradford
1895		Sharrott, Thomas Chilwell, B.A. (Dub.), A.R.C.S., F.I.C., Bovey Tracey School, Devon
1895	Trans.	‖Shaw, George Elliott, B.Sc. (Lond.), F.I.C., Assistant Quinologist, Mungpoo, Sonada, P.O., D.H. Railway, Bengal, India
1908		Shaw, William Bayliss, Lonsdale House, Walsall
1887		Sheard, John Tomlinson, Birley Carr, Sheffield
1905	Trans.	Shedden, Frank, B.Sc. (Lond.), F.I.C., Hurst-road, Hinckley
1899		Shelbourn, Edward Thomas, F.I.C., 40, Craven-street, Strand, W.C.
1904	Proc.	Shelton, Henry Stanley, B.Sc. (Lond.), Rushmere, Lower-park-road, Hastings
1897		Shenton, James Porter, 37, Torbay-road, Chorlton-cum-Hardy, near Manchester
1907	Trans.	Shepheard, Frederick George, B.Sc. (Lond.), A.R.C.S., A.I.C., 5, University-road, Galway, Ireland
1899	Trans.	Shepheard, William Frederick John, 12, Bridge-street-row, Chester
1906		Shepherd, Arthur Burton, B.Sc. (Vict.), F.I.C., c/o The British Oil and Cake Mills, Ltd., Copenhagen Mill, Limehouse, E.
1905		Shepherd, Charles Stuart, Rev., Beckott Cottage, Ombersley-road, Worcester
1874		‖Shepherd, Harcourt Henry Benjamin, F.I.C., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899		Shepherd, John William, B.Sc. (Lond.), 5, Cleveland-avenue, Merton Park, S.W.
1901	Trans.	Sheppard, Samuel Edward, D.Sc. (Lond.), 100, Bromley-road, Catford, S.E.
1901		Shepperson, William, The Pryors, East Heath-road, Hampstead, N.W.
1901		Sherwood, Edward Charles, Rev., M.A. (Oxon.), St. Laurence College, Ramsgate
1891	Trans.	‖Shields, John, D.Sc. (Edin.), Ph.D. (Strassburg), F.I.C., 4, Stanley-gardens, Cricklewood, N.W.

Date of Election.		
1896		Shimomura, Kotaro, Prof., Shinkarasumara, Kajinguchi Sagaru, Kyoto, Japan
1894		Shorthouse, Herbert Stephen, 144, Edmund-street, Birmingham
1906		Shrimpton, John Kirby, 22, Fountain's-terrace, North-road, Ripon
1904		Shrubsole, Alfred, 18, Forest-drive-west, Leytonstone, N.E.
1886		Shutt, Frank Thomas, M.A. (Toronto), F.I.C., Experimental Farm, Ottawa, Canada
1890		Shuttlewood, Willis Brewin, 78, Whitehall-park, Hornsey-lane, Highgate, N.
1894		Shuttleworth, Edward Buckingham, Prof., 220, Sherborne-street, Toronto, Canada
1904		Siau, Raymond Louis, 15, Merridale-lane, Wolverhampton
1903		Sibley, Samuel Edward, Tottenham, Warren-road, Marrickville, Sydney, N.S.W.
1859		Sibson, Alfred, 23, St. Mary Axe, E.C.
1889		Sibson, Alfred Edward, 19, Carlingford-road, Hampstead, N.W.
1903		Siddle, George, Middleton-one-row, S.O., Co. Durham
1902	Trans.	‖Sidgwick, Nevil Vincent, M.A. (Oxon.), D.Sc. (Tübingen), Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D. (Würzburg), Buckhurst Hill, S.O., Essex
1886		Silvester, Harry, Hon. B.Sc. (Birm.), F.I.C., 78, Holy Head-road, Handsworth, Birmingham
1906		Sime, Allan, Box 19, Port Limon, Costa Rica, S. America
1899	Trans.	Simmonds, Charles, B.Sc. (Lond.), Airdrie, 61, Cottenham-park-road, Cottenham-park, Wimbledon, S.W.
1889		Simmonds, Henry, Engineer's Office, Gas Works; and Elton View House, Bury, Lancs.
1887		‖Simmons, Leonard Owen, 2, Electric-mansions, Electric-avenue, Brixton, S.W.
1905		Simmons, William Herbert, B.Sc. (Lond.), Oakleigh, Stoke Newington Common, N.
1895		Simons, Albert Joseph, c/o M. Simons, Esq., 31, Little Britain, E.C.
1906	Trans.	Simonsen, John Lionel, M.Sc. (Manc.), 152, Barlow-moor-road, West Didsbury, Manchester
1896		Simpson, Aitken Megget, 364, Stanstead-road, Catford, S.E.
1902		Simpson, Duncan Ivan Rennard, P.O. Box 4225, Johannesburg, S. Africa
1897		Simpson, Edward Sydney, B.E. (Sydney), Geological Survey Laboratory, Museum-street, Perth, Western Australia
1886	Proc.	‖Simpson, William Selby, F.I.C., The Gables, Cannon-hill, Southgate, N.
1902	Proc.	Sindall, Robert Walter, 201, Wellmeadow-road, Catford, S.E.
1889		Singer, Ignatius, 3, Parkfield-road, Manningham, Bradford

Date of Election.		
1908		Singh, Puran, Acting Imperial Forest Chemist, Dehra Dun, U.P., India
1902	Proc.	Sinnatt, Frank Sturdy, Glenside, Church-lane, Moston, Manchester
1896		‖Sircar, Amrita Lal, 51, Sankaritola, Calcutta, India
1902		Skertchly, William Pearson, F.I.C., 11, Billiter-square, E.C.
1888	Trans.	Skinner, Sidney, M.A. (Cantab.), South Western Polytechnic, Manresa-road, Chelsea, S.W.
1899	Trans.	Skirrow, Frederick William, M.Sc. (Vict.), Ph.D. (Leipzig), 17, Curzon-avenue, Victoria-park, Manchester
1892		Skurray, Thomas, United Breweries, Abingdon, Berks.
1879		Slater, Charles, M.A. and M.B. (Cantab.), M.R.C.S. (Eng.), 81, St. Ermin's-mansions, Westminster, S.W.
1880	Trans.	‖Slater, Harold Humboldt, F.I.C., St. Lawrence, Borstal-road, Rochester, Kent
1903	Trans.	Slator, Arthur, Ph.D. (Leipzig), D.Sc. (Birm.), B.Sc. (Lond.), F.I.C., The Priory, Burton-on-Trent
1878		‖Slatter, George William, A.R.C.S.I., F.I.C., 241,Carlton-terrace, Nab Wood, Shipley, Yorks.
1895		Slocum, Frank Leroy, 401, South Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		‖Smetham, Alfred, F.I.C., Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1898	Trans.	Smiles, Samuel, D.Sc. (Lond.), University College, Gower-street, W.C.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	‖Smith, Alexander, Prof., Ph.D. (Munich), B.Sc. (Edin.), University of Chicago, Chicago, Ill., U.S.A.
1901		Smith, Andrew Biggam, c/o M. Armstrong, Esq., P.O. Box 90, Queenstown, Cape Colony, S. Africa
1888		Smith, Angus, F.I.C., 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, Benjamin Jordan, Grosvenor-road, Handsworth, Birmingham
1906		Smith, Charles, Knowsley-road, Smithills, Bolton
1903		Smith, Charles Joseph, Sunnydale, Walton New-road, Stockton Heath, near Warrington
1904	Trans.	Smith, Clarence, D.Sc. (Lond.), Aldersyde, Harpenden-road, Wanstead Park, E.
1894	Trans.	Smith, Claude, F.I.C., Barngarth, Cartmel, Carnforth
1884		‖Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1900		Smith, Edward Shrapnell, 4, Raymond-buildings, Gray's Inn, W.C.
1906		Smith, Frank, B.Sc. (Vict.), 407, Church-road, Smithills, Bolton
1906		Smith, Fred, Cliff House, Bruntcliffe, Leeds
1874		Smith, George, F.I.C., Nobel's Explosives Co., Polmont Station, N.B.

Date of Election.			
1896			Smith, George Egerton Scott-, F.I.C., 67, Surrey-street, Sheffield
1892			‖Smith, George Percy Darnell-, B.Sc. (Lond.), F.I.C., Board of Technical Education, Rutland-street, Auckland, New Zealand
1890			Smith, Harry Wood, B.Sc. (Vict.), c/o Messrs. John Batt and Co., Ltd., 39, Old Broad-street, E.C.
1896	Trans.		Smith, Henry George, The Technological Museum, Sydney, N.S.W.
1904			Smith, Henry Heron, F.I.C., 76, Plumstead-common-road, Plumstead, Kent
1878			Smith, Henry Russell, F.I.C., 1, Aubert-park, Highbury, N.
1900			‖Smith, Herbert Procter, Shotton-lane, Shotton, Flints.
1901			Smith, James, 80, Ampthill-road, Aigburth, Liverpool
1903			Smith, James Cruickshank, B.Sc., Holmdene, Colebrook-avenue, West Ealing, W.
1879			Smith, John William, 7, Brookfield-street, Roslindale, Boston, Mass., U.S.A.
1902			Smith, Leonard, Hillside, Park-hill-road, Croydon
1901	Trans.		Smith, Norman, D.Sc. (Vict.), The University, Manchester
1902			Smith, Robert Ely Blake, B.Sc. (Lond.), A.I.C., 31, St. John's-road, Putney, S.W.
1897			Smith, Robert Francis Wood, 90, Lower Thames-street, E.C.
1891			Smith, Robert Greig-, D.Sc. (Edin.), M.Sc. (Dun.), Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1907			Smith, Robert Harry, Apsley House, Priory-road, Sheffield
1907			Smith, Robert Low, 56, Genesta-road, Plumstead, S.E.
1888			Smith, Samuel, Hillsboro', Goddard-avenue, Old Swindon
1907			‖Smith, Sydney William, B.Sc. (Lond.), A.R.S.M., 76, Norroy-road, Putney, S.W.
1866	Trans.		Smith, Watson, F.I.C., 34, Upper-park-road, Haverstock Hill, N.W.
1876			‖Smith, William Alexander, M.A. and M.B. (Oxon.), M.R.C.S. (Eng.), 14, Durdham-park, Bristol
1903			Smith, William Veysey, B.A. (Oxon.), 38, St. Petersburgh-place, W.
1883	Trans.	C. 1896-1900 V.P. 1905-08	‖Smithells, Arthur, Prof., B.Sc. (Lond.), F.R.S., F.I.C., The University, Leeds
1873			‖Smyth, John, M.A. (Dub.), M.Inst.C.E., Milltown, Banbridge, Ireland
1908	Trans.		Smythe, John Armstrong, 15, The Poplars, Gosforth, Newcastle-on-Tyne
1902			Smythe, John Seabury, B.Sc. (Vict.), Ph.D. (Würzburg), Rantallard, Lance-lane, Wavertree, Liverpool
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc. (Lond.), Ph.D. (Göttingen), F.I.C., Balholm, Lathom-road, Southport

Date of Election.		
1899	Trans.	Soddy, Frederick, M.A. (Oxon.), Chemical Department, The University, Glasgow
1887		Sohn, Charles Emile, F.I.C., 52, Fore-street, E.C.
1891		Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1906		Sommerville, David, B.A. (R.U.I.), M.D., B.Ch., and D.P.H. (Cantab.), M.R.C.P. (Lond.), 31, Manor House, Marylebone-road, N.W.
1893		Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875		Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897	Proc.	Southerden, Frank, B.Sc. (Lond.), F.I.C., Royal Albert Memorial College, Exeter
1897		Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902		Southworth, William, Agricultural and Horticultural College, Uckfield, Sussex
1883		Soward, Alfred Walter, 28, Therapia-road, Honor Oak, S.E.
1892		Spackman, Charles, Rosehaugh, Clitheroe, Lancs.
1908		Speed, John Day, Mill House, Enfield Loch, Middlesex
1905		Speight, William Ewart, Corporation Sewage Works, Deighton, Huddersfield
1883		‖Spencer, Ernest Samuel, 27, Charlton-road, Blackheath, S.E.
1906	Trans.	Spencer, James Frederick, D.Sc. (L'pool), B.Sc. (Vict.), Ph.D. (Breslau), Bedford College for Women, Baker-street, W.
1886		Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887		‖Spencer, Walter Shelley, Lyndene, Darley-grove, Farnworth, near Bolton
1894		Spenzer, John George, Prof., M.D., Ph.D. (Strassburg), Ohio Wesleyan University, 1825, East 93rd street, N.E., Cleveland, Ohio, U.S.A.
1904		Spielmann, Percy Edwin, B.Sc. (Lond.), Ph.D. (Bâle), A.R.C.S., A.I.C., 21, Cadogan-gardens, S.W.
1908		Spiers, Charles Sedgley, Beaudesert, Queensland, Australia
1859	Trans.	‖Spiller, John, F.I.C., 2, St. Mary's-road, Canonbury, N.
1863		‖Spiller, William, F.I.C., 2, Lindfield-gardens, Hampstead, N.W.
1885		‖Spottiswoode, William Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1906	Trans.	Sproxton, Foster, B.Sc. (Lond.), Brantham Works, near Manningtree, Essex
1882		‖Squire, Peter Wyatt, 413, Oxford-street, W.
1892		Squires, Alfred James, Greenbank, Coroner's-lane, Farnworth, Widnes, Lancs.
1877		Stacey, Henry George, Brunton's Wharf, 671, Commercial-road-t, E.

Date of Election.		
1899		Stainer, John Ward, 103, Cheriton-road, Folkestone
1879	Trans.	‖Stallard, George, M.A. (Oxon.), Horton-crescent, Rugby
1904		Stanger, Reginald Harry Hursthouse, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W.
1902		Stanger, William Charles South, Ambleside, Corder-road, Ipswich
1904		Stanley, Harry, B.Sc. (Lond.), A.I.C., The Merchant Venturers' Technical College, Bristol
1887		‖Stansell, Lionel William, F.I.C., 7, Albion-place, Maidstone, Kent
1895		‖Stansfield, Alfred, D.Sc. (Lond.), McGill University, Montreal, Canada
1902		Stansfield, Edgar, M.Sc. (Vict.), Macdonald Chemistry and Mining Building, McGill University, Montreal, Canada
1899		Stansfield, Samuel, B.Sc. (Vict.), 2, Park-road, Batley, Yorks.
1900	Trans.	Stapleton, Henry Ernest, Prof., B.A. and B.Sc. (Oxon.), Presidency College, Calcutta, India
1870		Starey, Arthur John, 39, Woodland-gardens, Highgate, N.
1870	Trans.	‖Stark, James Fleming, Rosedale, Bromborough, Cheshire
1906		Starling, William Robert Rigg, 23, Magdalen-road, Norwich
1908		Stead, Arthur, B.Sc. (Vict.), 40, Victoria-road, Bloemfontein, Orange River Colony, S. Africa
1902		Stead, Francis Bernard, Clifton College, Bristol
1896		Stead, John Christopher, 1, Finsbury-circus, E.C.
1882	Trans.	Stead, John Edward, F.R.S., F.I.C., 11, Queen's-terrace, Middlesbrough
1897		Steel, Frederick William, c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Australia
1885		‖Steel, Robert Elliot, Cameron House, Sherborne, Dorset
1900	Trans.	Steele, Bertram Dillon, D.Sc. (Melbourne), The University, Melbourne, Australia
1905		Steger, James, B.Sc. (Lond.), 111, Chesterfield-road, Bristol
1898		Steinhart, Oscar Julian, Ph.D. (Erlangen), 2 and 3, West-street, Finsbury Circus, E.C.
1901		Stell, Samuel Fenton, 25, Henry-street, Keighley
1892	Trans.	‖Stenhouse, James, View-park-gardens, Bonnyrigg, Midlothian
1884		Stenhouse, Thomas, F.I.C., 166, Drake-street, Rochdale
1895	Trans.	Stephens, Frank Robert, c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880		‖Stephens, Henry Charles, Cholderton, Salisbury
1897		Stephens, Michael Edmund, 57, Aldersgate-street, E.C.
1895		Stephenson, Herbert Frederick, A.R.C.S., F.I.C., 7, Winifred-road, Merton Park, S.W.
1901		Stephenson, Robert, jun., M.A. (Cantab.), Burwell, Cambridge
1891	Trans.	Stephenson, Thomas, 137, George-street, Edinburgh

Date of Election.		
1888	Trans.	Stern, Arthur Landauer, D.Sc. (Lond.), F.I.C., 148, High-street, Burton-on-Trent
1896		Steuart, Douglas Stuart Spens, B.Sc. (Vict.), The Royal Societies' Club, St. James's-street, S.W.
1903	Trans.	Steven, Alec Bowring, B.Sc. (Lond.), Technical College, Glasgow
1905		Stevens, Edmund Henry, Haw House, Rothbury, Northumberland
1905		Stevens, Harold Blythen, 225, Oxford-street, W.
1897	Trans.	Stevens, Henry Potter, M.A. (Oxon.), Ph.D. (Heidelberg), F.I.C., 15, Borough, London Bridge, S.E.
1903		Stevens, Montague White, A.R.C.S., A.I.C., H.M. Patent Office, 25, Southampton-buildings, W.C.
1899		Stevenson, Arnold, B.A. (Cantab.), 4, Porchester-gardens, W.
1903	Trans.	Stevenson, Henry Edward, 155, Coventry-road, Ilford, Essex
1904		Stevenson, Henry Ernest, Avondale, Ditton Hill, Surrey
1879		Stevenson, William, 95A, Southwark-street, S.E.
1908		Stewart, Alexander Mackintosh, Penang, Straits Settlements
1903	Trans.	Stewart, Alfred Walter, D.Sc. (Glas.), 53, Shaftesbury-road, Ravenscourt Park, W.; and 18, Annfield-terrace, Partickhill, Glasgow
1902		Stewart, Hector, Gulf Creek Copper Mine, via Barraba, N.S.W.
1872		‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1907		Stobie, Harold Ramsay, Box 367, Haileybury, Ontario, Canada
1866		Stock, William Frederick Keating, F.I.C., 5, Dixon-terrace, Darlington
1874		‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcs.
1887		Stocks, Herbert Birtwhistle, F.I.C., 12, Victoria-road, West Kirby, Cheshire
1894	Trans.	Stoddart, Frederick Wallis, F.I.C., Grafton Lodge, Sneyd-park, Bristol
1879	Proc.	‖Stokes, Alfred Walter, F.I.C., Town Hall, Paddington Green, W.
1908		Stokes, Edward, B.A. (Oxon. and Adelaide), District School, Bareilly, U.P., India
1873		‖Stone, Edward Daniel, Ackersley, Cheadle Hulme, near Stockport, Cheshire
1895		Stone, George, Esk Brewery, Launceston, Tasmania
1875		‖Stone, John Frederic Matthias Harris, M.A. (Cantab.), Barrister-at-Law of the Western Circuit, 3, Dr. Johnson's-buildings, Temple, E.C.; and Oxford and Cambridge Club, 17, Pall Mall, S.W.
1879		‖Stone, William, M.A. (Cantab.), Oxford and Cambridge, Garrick, Bath, Union and Reform Clubs; and 63, Curzon-street, Mayfair, W.

Date of Election.		
1906		Storey, Francis Wylie, B.Sc. (Lond.), Government School, Bethlehem, Orange River Colony, S. Africa
1900		Storr, Bertram Vincent, M.Sc. (Vict.), 147, Coventry-road, Ilford, Essex
1887		||Strangman, James Pim, Clydesdale-mansions, 9, Clydesdale-road, Notting Hill, W.
1904	Trans.	Streatfeild, Frederick Henry, 9, Crescent-road, South Tottenham, N.
1906		Streimer, Emanuel George, Park House, Margery-park-road, Forest Gate, E.
1900		Strong, Archie Hugh, 63, Herne-hill-road, Camberwell, S.E.
1904	Trans.	||Struthers, Robert de Jersey Fleming-, M.A. and B.Sc. (Oxon.), Exeter College, Oxford
1885	Trans.	||Stuart, Charles Maddock, M.A. (Cantab.), F.I.C., St. Dunstan's College, Catford, S.E.
1897	Trans.	Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1907		Sturrock, George Colleymore, Capt. R.A., Indian Cordite Factory, Aruvankad, Nilgiris, India
1890	Trans.	||Sudborough, John Joseph, Prof., D.Sc. (Lond.), Ph.D. (Heidelberg), F.I.C., University College of Wales, Aberystwyth
1878	Trans.	||Suguira, Shigetake, c/o Tokyo Chemical Society, Science College, Imperial University, Tokyo, Japan
1897		Sumner, Leonard, B.Sc. (Vict.), Butt Hill, Prestwich, near Manchester
1907		Sutcliffe, Samuel Mortimer, 4, Clive-place, Bradford
1904		Sutcliffe, Thomas, The Grammar School, Elland, Yorks.
1887		||Sutherland, David Alexander, F.I.C., 26, Victoria-street, Westminster, S.W.
1860		Sutton, Francis, F.I.C., Laboratory, Bank Plain, Norwich
1886		||Sutton, Francis Napier, F.I.C., 6, Grosvenor-gardens, Cricklewood, N.W.
1902		Swain, James, 17, Winsham-grove, Clapham Common, S.W.
1875		Swan, Sir Joseph Wilson, Hon. M.A. and Hon. D.Sc., (Dun.), F.R.S., F.I.C., Overhill, Warlingham, Whyteleaf, S.O., Surrey
1894		||Swinburne, James, F.R.S., 82, Victoria-street, S.W.
1891		Sykes, Matthew Carrington, M.D. (Dun.), F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. and D.P.H. (Lond.), Sykeshurst, Barnsley, Yorks.
1880		Symons, Brenton, Burwood, Warminster-road, South Norwood, S.E.
1874	Trans.	||Symons, William Henry, M.D. (Brussels), D.P.H. (Oxon.), M.R.C.S. (Eng.), F.I.C., Health Office, Guildhall, Bath
1899	Trans.	Szarvasy, Charles Emerique, Prof., Ph.D. (Buda Pesth), Müegyetem I Ker., Budapest, Hungary

Date of Election.		
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokyo, Japan
1887	Trans.	‖Takamine, Jokichi, 521, West 179th-street, New York City, U.S.A.
1906		Talbot, George Stanley, c/o Pacific Phosphates Co., 60A, Pitt-street, Sydney, N.S.W.
1901		Tankard, Arnold Rowsby, F.I.C., 63, Somerset-road, Newport, Mon.
1901		Tatam, George William Gerald, 105, Linwood-avenue, Pawtucket, Rhode Island, U.S.A.
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D. (Würzburg), F.I.C., Windsor Buildings, George-street, Liverpool
1884		‖Tate, Walter, Woodlands, Twerton-on-Avon, Bath
1890		Tate, William, Prof., Civil Engineering College, Sibpur, near Calcutta, India
1867		Tatlock, Robert Rattray, F.I.C., 11, Bellshaugh-road, Kelvinside West, Glasgow
1882		Taylor, Gotfred Midgley, Caxton House, Westminster, S.W.
1894		Taylor, Herbert John, 52, Alexandra-crescent, Dewsbury
1880		‖Taylor, James, B.Sc. (Manc.), A.R.S.M., Adderton, Dundas, N.S.W.
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John George, 3, Outram-street, Stockton-on-Tees
1905		Taylor, John William, University College, Reading
1874	Trans.	‖Taylor, Robert Llewellyn, F.I.C., 4, St. Werburgh's-road, Chorlton-cum-Hardy, Manchester
1901		Taylor, William Henry, B.Sc. (Lond.), F.I.C., 20, Balcaskie-road, Eltham Park, Kent
1878		‖Tcherniac, Joseph, Ph.D. (Zürich), c/o South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1907		Tebb, William Scott, M.A., M.D. and D.P.H. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), L.S.A., F.I.C., Sandfield, Putney Heath-lane, S.W.
1879	Trans.	‖Teed, Frank Litherland, D.Sc. (Lond.), F.I.C., 9, Mincing-lane, E.C.
1906		Telling, Harry George, Cooksbridge Brewery, Cooksbridge, Sussex
1906		Tempany, Harold Augustine, B.Sc. (Lond.), F.I.C., St. Johns, Antigua, British West Indies
1907		Templeton, William Sandilands, Prof., M.A. and B.Sc. (Glas.), Medical and Technical College, Colombo, Ceylon
1894		‖Terry, Edwin, 374, Brixton-road, S.W.
1881		Tervet, Robert, 68, Windsor-road, Leyton, Essex
1893		Thackrah, James Robert, M.A. (Oxon.), Ph.D. (Leipzig), Technical Schools, Tavistock-road, Plymouth

Date of Election.			
1895			Theodosius, Alfred Fletcher, M.A. (Oxon.), University College, Oxford
1904			Thibault, Paul John, Howell, N.S.W.
1899			Thiersch, Harry Alexander, c/o British Resin Works, Ltd., Belvedere, S.O., Kent
1901			Thomas, Albert Edward, B.Sc. (Lond.), F.I.C., Boys' Middle School, Castle-street, Tiverton, Devon
1871			‖Thomas, Charles, J.P., Stoke Bishop, near Bristol
1907	Trans.		‖Thomas, Frederick, M.Sc. (Manc.), 29, Fairhaven-road, St. Anne's-on-the-Sea, Lancs.; and The University, Leeds
1905			Thomas, George Devenish, B.Sc. (Lond.), 18, Randolph-gardens, Dover
1874			Thomas, Harry Edgecumbe, Rockleaze Point, Clifton, Bristol
1875	Trans.		‖Thomas, Joseph William, F.I.C., Overdale, 6, Kingswood-road, Shortlands, Kent
1907	Trans.		Thomas, Richard Noel Garrod, B.A. (Oxon.), 25, Clytha-park, Newport, Mon.
1877			‖Thompson, Beeby, 67, Victoria-road, Northampton
1904			Thompson, Charles Herbert, Harrington House, Amblecote, Stourbridge
1886	Trans.		‖Thompson, Claude Metford, Prof., M.A. (Cantab.), D.Sc. (Lond.), University College, and 38, Park-place, Cardiff
1894			Thompson, Edward Cumming, 32, Ulundi-road, Westcombe Park, S.E.
1893			Thompson, Frank Ernest, A.R.C.S., A.I.C., 51, Lichfield-road, Walsall
1893			Thompson, George Rudd, F.I.C., The Laboratory, 69, Dock-street, Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1904			Thompson, Hubert, B.Sc. (Vict.), Agricultural College, Holmes Chapel, Cheshire
1886			Thompson, William Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1903			Thomson, George Malcolm, Newington, Dunedin, New Zealand
1872	Trans.	C. 1880-3, 1904-06 S. 1883-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., Hon. LL.D. (Glas.), F.R.S., F.I.C., King's College, Strand, W.C.; and 9, Campden Hill-gardens, W.
1899			Thomson, Robert Tatlock, F.I.C., 156, Bath-street, Glasgow
1872			Thomson, William, F.I.C., Royal Institution Laboratory, Manchester
1895			Thomson, William Thomas, Oxford-villas, Waltham Abbey
1906			Thorne, Emanuel Isaac, 13, Cantwell-road, Plumstead, S.E.

Date of Election.			
1882	Trans.		Thorne, Leonard Temple, Ph.D. (Würzburg), F.I.C., 2, Denbigh-gardens, Richmond, Surrey
1906			Thornton, Percy Charles, Council School, Arnot-street, Walton, Liverpool
1906			Thorp, Arthur William, 210, Sherborne-road, Yeovil
1891			Thorp, Walter, B.Sc. (Lond.), F.I.C., Sorrentoville, Dalkey, Co. Dublin
1893	Trans.		Thorpe, Jocelyn Field, D.Sc. (Manc.), Ph.D. (Heidelberg), F.R.S., The University, Manchester; and Yannaford, Heaton Mersey, Lancs.
1871	Trans.	C.1879-83 V.P. 1884-7 T. 1889-99 P. 1899-1901	†‖Thorpe, Thomas Edward, Prof., C.B., D.Sc. (Vict.), Sc.D. (Dub.), Ph.D. (Heidelberg), LL.D. (Glas.), F.R.S., Government Laboratory, Clement's Inn-passage, W.C.
1899	Trans.		Threlfall, Richard, Prof., M.A. (Cantab.), Assoc. M. Inst. C. E., F.R.S., 30, George-road, Edgbaston, Birmingham
1897	Trans.		‖Tickle, Thomas, B.Sc. (Lond.), F.I.C., 83, Queen-street, Exeter
1902			Tidy, Henry Letheby, M.A., M.B., and B.Ch. (Oxon.), M.R.C.S. (Eng.), M.R.C.P. (Lond.), 103, Clarence-gate-gardens, Regent's Park, N.W.
1903			Tighe, Arthur, Invirurie, Pymble, Sydney, N.S.W.
1903			Tilburn, Charles, c/o The Australian Explosives and Chemical Co., Ltd., Deer Park, Victoria, Australia
1865	Trans.	C. 1878-81 V.P. 85-8 91-4, 96-9 T. 1899-03 P.1903-05	‖Tilden, William Augustus, Prof., D.Sc. (Lond.), Hon. Sc.D. (Dub.), Hon. D.Sc. (Vict.), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.; and The Oaks, Northwood, S.O., Middlesex
1900			Tilley, James Walter, 95a, Southwark-street, S.E.
1905			Tillott, John Booty, 55, Wood-street, Westminster, S.W.
1907			Timpany, Harold Munkman, M.Sc. (Vict.), St. Winifrede's-gardens, Shrewsbury
1904	Trans.		Tingle, Alfred, B.Sc. (Lond.), Ph.D. (Penn.), c/o No. 5 Post Office, Ho Pei, Tientsin City, North China
1889	Trans.		‖Tingle, John Bishop, Prof., Ph.D. (Munich), McMaster University, Toronto, Canada
1907	Trans.		Tinkler, Charles Kenneth, B.Sc. (Wales), The University, Edmund-street, Birmingham
1898			Tisdale, Charles William Walker, The Dairy, Northallerton, Yorks.
1905	Trans.		Titherley, Arthur Walsh, D.Sc. (Vict. and L'pool.), Ph.D. (Heidelberg), Southcot, Manor-hill, Upton, near Birkenhead
1907			Toch, Maximilian, 52, Ninth-street, Long Island City, N.Y., U.S.A.
1891			Tocher, James Fowler, B.Sc. (Aberd.), F.I.C., 5, Chapel-street, Peterhead

† Longstaff Medallist, 1881.

Date of Election.		
1903		Tolson, Stanley, The Croft, Abbey Wood, S.E.
1884	Trans.	‖Tompson, Frederick William, The Bower, Limpsfield, S.O., Surrey
1877		‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1904		Tong, Walter, Holmdene, Pole-lane, Failsworth, Manchester
1904		Tonkin, Arnold Bertram, Government Laboratory, Durban, Natal, S. Africa
1906		Tonkin, Ronald William, 37, Oak-hill-road, Putney, S.W.
1907		Tonner, William Griffiths, B.Sc. (Wales), Tynybonau-road, Pontardulais, Glam.
1893		‖Towers, John William, Victoria-road, Widnes
1903		Toyne, Francis Digby, M.A. (Cantab.), 144, Tweedale-street, Rochdale, Lancs.
1901		Tozer, Herbert Ackerman, B.A. (Lond.), Jesmond, Edith-road, Selhurst, S.E.
1887		‖Traphagen, Frank W., Prof., Ph.D. (New York), Colorado School of Mines, Golden, Colorado, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris William, Prof., D.Sc. (Lond.), F.R.S., Indian Institute of Science, Bangalore, India; and c/o Messrs. Jeremiah Lyon and Co., 4, Lombard-court, E.C.
1906		Treble, Richard Lumley, B.Sc. (Dun.), 2, Rectory-terrace, Gosforth, Newcastle-on-Tyne
1908		Trechmann, Adolph Octavius, The Old Palace, Rochester, Kent
1895		Trehärne, Frederick Gwilym, Wrangbrook, Llanishen, near Cardiff
1888		‖Trewby, Herbert, 62, St. John-street, E.C.
1881		‖Trigger, Oliver, F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1902		Trimen, Stephen Herbert, Survey Dept., Finance Ministry, Giza, Egypt
1897		Tripp, Edward Howard, Ph.D. (Marburg), The Modern School, Bedford
1905		Troye, Gustave Arthur, P.O. Box 2706, Johannesburg, S. Africa
1905	Trans.	Tuck, William Bradshaw, B.Sc. (Lond.), University College, Gower-street, W.C.
1898	Trans.	Tucker, Samuel Auchmuty, Ph.B. (Columbia), Columbia University, New York, U.S.A.
1889		Tucker, Willis Gaylord, M.D. (Albany), Ph.D. (Union Univ.), Medical College, Albany, New York, U.S.A.
1896		Tuckett, James Edwin Shum, M.A. (Cantab.), Marlborough College, Marlborough
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancs.
1902		Tunnicliffe, William Wright, B.Sc. (Lond.), Sunnyside, Newhall, Burton-on-Trent

Date of Election.		
1897		Turnbull, Andrew, Ph.D. (Heidelberg), 3, Lord-street, Liverpool
1906	Trans.	Turnbull, Robert Hutchison, F.I.C., c/o Messrs. MacAndrews and Forbes Co., 3rd-street and Jefferson-avenue, Camden, N.J., U.S.A.
1903		Turner, Arnold, 84, Molesworth-street, Rochdale
1886		Turner, Arthur, The Limes, Aylesbury
1897		Turner, Basil William, 83, Pitt-street, Sydney, N.S.W.
1896		Turner, Benjamin Bernard, B.Sc. (Lond.), Ph.D. (Göttingen), c/o Rev. F. Storrs Turner, Ivanhoe, Portland-road, East Grinstead, Sussex
1888	Trans.	Turner, Charles, 225A, Oxford-street, Manchester
1906		Turner, George Augustus, 12, The Foregate, Worcester
1897		Turner, John Scriven, 20, Bury-street, Bloomsbury, W.C.
1883	Trans.	‖Turner, Thomas, Prof., M.Sc. (Vict.), A.R.S.M., F.I.C., The University, Edgbaston, Birmingham
1903	Trans.	Turner, William Ernest Stephen, M.Sc. (Birm.), B.Sc. (Lond.), The University, Sheffield
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab.), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robert, Albion House, The Marina, Deal
1905	Trans.	Tutin, Frank, 9, Haverfield-gardens, Kew, Surrey
1888	Trans.	Tutton, Alfred Edwin Howard, M.A. and D.Sc. (Oxon.), F.R.S., 41, Ladbroke-square, W.
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1907		Twiney, William George, B.Sc. (Lond.), St. Joseph's College, Colombo, Ceylon
1904	Trans.	Twiss, Douglas Frank, M.Sc. (Birm.), A.I.C., The Municipal Technical School, Suffolk-street, Birmingham
1899	Trans.	Tyler, Ernest Albert, B.A. (Cantab.), 33, The Promenade, Mount Pleasant, Swansea
1876		Typke, Paul George William, F.I.C., Lawn House, New Malden, Surrey
1876		Tyrer, Thomas, F.I.C., Stirling Chemical Works, Abbey-lane, Stratford, E.
1903		Tyrrell, Dennis, 182, King-street, Norwich
1908		Tyson, Thomas Marshall, 109, Carpenters-road, Stratford, E.
1876		‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffs.
1865		Umney, Charles, F.I.C., 50, Southwark-street, S.E.
1893	Trans.	Umney, John Charles, 50, Southwark-street, S.E.
1889		‖Underhill, Thomas John, Stanley, Quernmore-road, Bromley, Kent
1904		Underhill, William Wood, 10, Hartham-road, Holloway, N.

Date of Election.			
1897			‖Unwalla, Rustomji Navroji, MedicalDept., Bhaunagar, Kathiawâr, India
1908			Unwin, Harry James, Egstow, Market-place, Clay Cross, Chesterfield
1882			‖Vacher, Francis, F.R.C.S., and M.R.C.P. (Edin.), c/o Dr. Kenyon, Flookersbrook, Chester
1890			Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1903			Van Laer, Norbert, c/o Messrs. Truman, Hanbury, Buxton and Co., Ltd., Burton-on-Trent
1901			Varley, Harold Fay Fleetwood, 16, Olympia-gardens, Morpeth, Northumberland
1883			Vasey, Samuel Archibald, F.I.C., Beechcroft, Burnt Ash-lane, Bromley, Kent
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor Herbert, M.A. and D.Sc. (Oxon.), F.R.S., 8, Marlborough-place, N.W.
1891			Velling, Frederick William de, B.A., Higher Grade Board School, The Boulevard, Hull
1881			Venable, Francis Preston, Ph.D. (Göttingen), Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas José Maria, Apartado No. 237, Bogotá, Colombia
1901			Verteuil, Joseph de, Clarence-street, Port of Spain, Trinidad, British West Indies
1897			Viccajee, Framjee Khurshedjee, Mount Villa, New-road, Chudderghaut, Hyderabad, Deccan, India
1908			Vidyant, Hari Prasad, M.A. (Allahabad), Irrigation Branch, Public Works Dept., Etawah, U.P., India
1884			‖Voelcker, Edward William, A.R.S.M., F.I.C., 22, Tudor-street, Blackfriars, E.C.
1884		C.1891-5, 1902-04	‖Voelcker, John Augustus, Hon. M.A. (Cantab.), Ph.D. (Giessen), B.A. and B.Sc. (Lond.), F.I.C., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖Voss, Walter Arthur, Eastwood-road, Rayleigh, Essex
1885			Vulté, Hermann T., Ph.D., Columbia University, New York City, U.S.A.
1901			‖Wade, Frank, A.R.C.S., F.I.C., 26, St. Ronan's-avenue, Southsea; and Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.	C. 1905-	‖Wade, John, D.Sc. (Lond.), F.I.C., Hunstanton Lodge, Downe, Kent; and Guy's Hospital, London Bridge, S.E.

Date of Election.			
1903	Trans.		Wadmore, John Mello, M.A. (Oxon.), Aldenham School, near Elstree, Herts.
1901			Wager, Morton Ethelred, B.Sc. (Lond.), Holme Cottage, Mytholmroyd, S.O., Yorks.
1894			‖Wagner, William George, Glyndhurst, Ealing Common, W.
1893			Wait, Charles E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			‖Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada
1899			Walden, Allan Frederick, M.A. (Oxon.), 37, High-street, and New College, Oxford
1897			Walford, Samuel Matthew, Wyncote, Hatherlow, Stockport
1881			‖Walker, Archibald, M.A. (Oxon.), F.I.C., 7, Crown-terrace, Dowanhill, Glasgow
1898	Trans.		‖Walker, Andrew Jamieson, Ph.D. (Heidelberg), B.A. (Dub.), Municipal Technical College, Derby
1899			Walker, Charles, Kuranda, Waverley-street, Waverley, N.S.W.
1894	Trans.		Walker, Charles Henry Hirst, M.A. (Oxon.), Secondary School, Oldbury, Birmingham
1889			Walker, Daniel, School of Mines, Ballarat, Victoria, Australia
1906			Walker, Franklin Wilfred, 48, Blandford-road, Bedford Park, W.
1908			Walker, Herbert, Whyttington, Station-road, Wealdstone, N.W.
1890	Trans.	C. 1899-04	‖Walker, James, Prof., D.Sc. (Edin.), Ph.D. (Leipzig), F.R.S., The University, Edinburgh
1890			Walker, James Samuel Hourston, M.B. and C.M., (Edin.), D.P.H. (Cantab.), Clinical Research Association, Watergate House, Adelphi, W.C.
1897	Trans.		Walker, James Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1888			Walker, John Thom Ainslie, 64, Cannon-street, E.C.
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey, Manchester
1898			Walker, Samuel, M.A. and D.Sc. (Edin.), 126, Gilmore-place, Edinburgh
1903			Walker-Pole, Miles, 71, De Korle-street, Braamfontein, Johannesburg, S. Africa
1905			Wall, Francis Henry, 15, Barratt-street, Southport, Lancs.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, A.M. (Harvard), Ph.D. (Columbia), 7, Franklin-place, Morristown, N.J., U.S.A.
1904			Walling, Léon Edward, 16, Beechhill-road, Eltham, Kent
1902			‖Wallis, Thomas Edward, B.Sc. (Lond.), F.I.C., 96, Stephens-road, Tunbridge Wells, Kent

Date of Election.		
1883		‖Walmsley, Robert Mullineux, D.Sc. (Lond.), Northampton Institute, St. John-street, Clerkenwell, E.C. ; and 23, Hilldrop-road, Camden-road, N.
1905		Walpole, George Stanley, B.Sc. (Melbourne), A.I.C., Lister Institute of Preventive Medicine, Chelsea-gardens, S.W.
1888		Walrond, Edward Dalrymple, M.A. (Cantab.), North Eastern County School, Barnard Castle, Durham
1903		Walsh, Thomas Crosbie, 42, Muswell-avenue, Muswell Hill, N.
1899		Walton, Robert Hawks, Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884		‖Walton, Thomas Utrick, B.Sc. (Glas.), F.I.C., Colonial Sugar Refining Co., Sydney, N.S.W.
1905		Want, William Phillip, 11, Pearfield-road, Forest Hill, S.E.
1864		Ward, George, F.I.C., Buckingham-terrace, Headingley, Leeds
1895		Ward, George John, Hallam Fields, Ilkeston, S.O., Derbyshire
1908		Ward, Herbert Horace, University College of Wales, Aberystwyth
1891		Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875		Wardle, Sir Thomas, Leek, Staffs.
1907		Warner, Charles Horne, A.I.C., 24, Gordon-street, Gordon-square, W.C.
1871		Warner, George Joseph, Halton Villa, Widnes
1906		Warren, Richard Alfred, Belle Vue, Hallow-road, Worcester
1888		Warrick, Frederic Walmsley, 6, Nile-street, City-road, N.
1895		Warrington, Thomas Cotterill, M.A. (Oxon.), 29, Stockwell-street, Leek, Staffs.
1906		Wasteneys, Hardolph, Board of Waterworks, Brisbane, Queensland, Australia
1882		Waterfall, Charles James, F.I.C., 4, Queen-square, Bristol
1901		‖Waterhouse, James, Major-General, I.S.C., Hurstmead, High-street, Eltham, Kent
1894		Waterhouse, Robert, 8, Severn-road, Sheffield
1907		Watkins, Charles Rowlatt, B.A. (Cantab.), Madras Club, Madras, India
1908		Watkins, Edwin John, 10, Montpelier-road, Queen's-road, Peckham, S.E.
1893		Watson, Alexander Forbes, B.Sc. (Edin.), F.I.C., Laboratory, Watling-street, Dublin
1885		‖Watson, Charles, Fairfield, Washwood Heath-road, Birmingham
1904	Trans.	Watson, Edwin Roy, M.A. (Cantab.), B.Sc. (Lond.), Civil Engineering College, Sibpur, Calcutta, India
1887		‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1899		Watson, Fred Sheasby, B.Sc. (Vict.), Sandgate, Villiers-road, Woodthorpe, Nottingham

Date of Election.			
1906			Watson, Frederick William, B.Sc. (Lond.), F.I.C., Consolidated Gold Fields of South Africa, Ltd., P.O. Box 108, Germiston, Transvaal, S. Africa
1907			Watson, George Arthur, A.R.C.S.I., Clongowes Wood College, Sallins, S.O., Co. Kildare, Ireland
1908			Watson, Herbert Edmeston, B.Sc. (Lond.), A.I.C., Tringhurst, Cranes-park, Surbiton, B.O., Surrey
1904			Watson, Herbert Wood, B.Sc. (Vict.), c/o H. Hogarth, Esq., Denton Avenue, Gledhow, Leeds
1908			Watson, John, B.Sc. (Dun.), 5, Kendrew-street, Darlington
1906			Watson, John Adam, 8, Powis-gardens, Notting Hill, W.
1883		‖	Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1876	Trans.	‖	Watson, William Henry, J.P., Braystones House, Beckermet, Cumberland
1877			Watt, Alexander, F.I.C., c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1904			Watt, Francis Langston, A.R.C.S., F.I.C., Russenden, Stanley-street, Epping, near Sydney, N.S.W.
1906			Watt, George Gordon, 26, Albert-square, Clapham-road, S.W.
1906			Watt, Henry Edgar, D.Sc. (Dun.), A.I.C., Imperial Institute, South Kensington, S.W.
1883	Trans.		Watts, Hon. Francis, C.M.G., Hon. D.Sc. (Birm.), F.I.C., Government Laboratory for the Leeward Islands, Antigua, West Indies
1906			Watts, James Neill, P.O., Eikenhof, Johannesburg, S. Africa
1872	Trans.	‖	Watts, John, M.A. (Oxon.), D.Sc. (Lond.), F.I.C., Merton College, Oxford
1878	Trans.		Watts, John Isaac, Beechfield, Hartford, Cheshire
1888			Way, Edward John, F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal, S. Africa
1901			Wayland, William Abraham, 12, Albert-road, St. John's, S.E.
1902			Webb, Arthur James, M.A. (Oxon.), B.Sc. (Lond.), Assoc.M.Inst.Mech.E., c/o Messrs. Johnson, Matthey & Co., Ltd., 78, Hatton-garden, E.C.
1883	Trans.		Webster, Charles Stuart Stanford, F.I.C., Malvern House, Redland, Bristol
1866			Webster, George Watmough, 1, Grange-road, West Kirby, Birkenhead
1877			Webster, William, 50, The Park, Blackheath, S.E.
1906	Trans.		Wechsler, Elkan, Ph.D. (Würzburg), 59, Petherton-road, Canonbury, N.
1907			Wechsler, Marcus, D.Sc. (Grenoble), 136, Sinclair-road, Kensington, W.

Date of Election.		
1904		Weeks, Henry Bridges, F.I.C., The Retreat, Infield-park, Barrow-in-Furness
1905		Weiskopf, Eric H., Dynamite Factory, Modderfontein, Transvaal, S. Africa
1903		Weiss, Carl Friederich Richard, M.A., Ph.D., (Bâle), 27A, St. Mary-at-hill, E.C.
1898		Weissmüller, Edward Charles, Hill Crest, The Heath, Runcorn
1901		Welch, George Edward, B.Sc. (Lond.), Grammar School, Wakefield
1888		Welch, John Cuthbert, c/o Cymru Copper Co., Ketchikan, Alaska, U.S.A.
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen Newcombe, Assoc.M.I.E.E., c/o Coke Ovens and By-Products Co., Ltd., 141-143, Palace-chambers, Westminster, S.W.
1884	Trans.	Wells, James S. Chester, Ph.D. (Columbia), Columbia University, New York City, U.S.A.
1890		Wells, Sydney Russell, M.D. and B.Sc. (Lond.), M.R.C.S. (Eng.), M.R.C.P. (Lond.), 16, Lower Seymour-street, Portman-square, W.
1903		Welsford, Giles Haddon, Royal Gunpowder Factory, Waltham Abbey, Essex
1897		Welsh, John, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 43, Tarvin-road, Chester
1888	Trans.	Werner, Emil Alphonse, F.I.C., 5, Church-avenue, Rathmines, Dublin
1886		‖Wertheimer, Julius, Prof., B.A., B.Sc. (Lond.), F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, Charles Alfred, A.R.C.S., F.I.C., 95, Oakhill-road, East Putney, S.W.
1899		West, George Hardstaff, B.Sc. (Lond.), County School, Pembroke Dock
1902		West, Joseph, Bank House, Fenton, Stoke-on-Trent
1898		Weston, Frank Edwin, 43, Larkhall-rise, Clapham, S.W.
1892		Whalley, Lawrence John de, 148, Jerningham-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc. (Lond.), 18, Nevilledale-terrace, Durham
1908		Wheatley, William, B.A. (Oxon.), 21, Bairstow-street, Preston, Lancs.
1906		Wheaton, Harold Joseph, 21, Chesterton-road, Cambridge
1907		Wheeler, Edward, A.C.G.I., 113, Highbury-quadrant, N.
1902		Wheeler, Edward J., Ph.D., 79, Chapel-street, Albany, N.Y., U.S.A.
1905		Wheeler, Ernest, c/o Messrs. Crossley Bros., Openshaw, Manchester

Date of Election.		
1894		Wheeler, Henry Lord, Ph.D. (Yale), The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest, 43, Haverstock-road, Knowle, Bristol
1897		Wheelwright, Edwin Whitfield, B.A. (Oxon.), Ph.D. (Munich), F.I.C., Greenholme, 24, Stanmore-road, Edgbaston, Birmingham
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford
1897		White, Arthur James, 243, Albert-road, Jarrow-on-Tyne
1891		White, Henry, 245, Western-road, Crookes, Sheffield
1893		White, Henry Clay, Prof., Ph.D. (Virginia), Hon. D.C.L. (Univ. South), Hon. LL.D. (Illinois), University, Athens, Georgia, U.S.A.
1899		White, Henry Fox, 52, Royal York-crescent, Clifton, Bristol
1905		White, John Ledger, D.Sc. (Dun.), 9, Sugden-road, Lavender Hill, S.W.; and Battersea Polytechnic, Battersea Park-road, S.W.
1889		‖White, John Tsawoo, M.A. (Calcutta), Pyinmana, Upper Burma, India
1905		White, John William, B.Sc. (Lond.), c/o The E.C. Powder Co., Green Street Green, Dartford
1897		White, Paul Thomas, Hortonfield House, West Drayton, Middlesex
1902		White, William Carter, Glenholme, Longlands-park-road, Sidcup, S.O., Kent
1893		White, William Gilchrist, Vicarage View, 133, Tottington-road, Bury, Lancs.
1885		Whitehead, Henry Hammond, Holland House, Spring-grove, Isleworth, W.
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, Philip Lewington, c/o W. H. Keys, Esq., Hall End Works, West Bromwich
1889		‖Whitehouse, William, Albany House, Bradmore, Wolverhampton
1904	Trans.	Whiteley, Charles Edward, 21, Brudenell-view, Leeds
1886	Proc.	‖Whiteley, Richard Lloyd, F.I.C., Municipal Science and Technical School, West Bromwich
1892		Whiteside, John Lowe, 376, St. Helen's-road, Bolton
1863		‖Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, Christopher Joseph, West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, Ansdell, Lytham
1889		Whittam, Matthew, M.A. (Cantab.), 75, Creffield-road, West Acton, W.
1901		Whittle, James, 30, Bridge-street, Morpeth
1907		Whymper, Robert, A.C.G.I., St. Clare, St. Mary's-road, Ditton Hill, Surrey

Date of Election.		
1900		Wiechmann, Ferdinand Gerard, Ph.D. (Columbia), P.O. Box 79, Station W., Brooklyn, N.Y., U.S.A.
1906		Wiffen, Henry John, 17, Albany-road, Manor-park, E.
1889		Wigan, Basil Penwarne, Rhondda Valley Brewery Co., Treherbert, Pontypridd
1905		Wigginton, John Henry Becker, 7, Byfeld-gardens, Barnes, S.W.
1907		Wight, Robert Burt, M.A. (Cantab.), 3, Clarendon-terrace, Linthorpe-road, Middlesbrough
1906		Wightman, Charles, 36, Curzon-street, W.
1896	Proc.	Wigner, John Harrison, Ph.D. (Heidelberg), 54, Keptie-street, Arbroath, N.B.
1896		Wilcox, Alfred James, Rev., Shapwick, Blandford
1891		‖Wild, John, B.Sc. (Vict.), A.I.C., Bredbury House, Bredbury, Stockport
1898		‖Wild, William Ernest, B.Sc. (Vict.), Alexander-villas, Talbot-road, Glossop
1898		Wilder, Frederick Louis, Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans.	Wilderman, Meyer, Ph.D. (Freiburg), B.Sc. (Oxon.), Davy-Faraday Research Laboratory, Albemarle-street, W.
1881		Wilkes, John Potter, 54½, Old Broad-street, E.C.
1902	Trans.	Wilkinson, Edward John, 12, Mansfield-road, Manningham, Bradford
1904		Wilkinson, James Alfred, M.A. (Cantab.), Transvaal University College, P.O. Box 1176, Johannesburg, S. Africa
1903		Wilkinson, James Bates, M.D. and C.M. (Edin.), D.P.H. (Vict.), Town Hall, Oldham
1893		Wilkinson, John, Corporation Gas Works, Halifax
1905		Wilkinson, John Wells, M.A. (Wales), Longhope, Essendene-road, Belvedere, S.O., Kent
1891		Will, Wilhelm, Prof., Ph.D. (Berlin), Colonie Grunewald, Boothstrasse 32, bei Berlin, Germany
1904	Proc.	Willcox, William Henry, M.D., B.Sc., M.R.C.P. and L.S.A. (Lond.), D.P.H. (Eng.), F.I.C., St. Mary's Hospital, Paddington, W.
1906		Willett, Herbert William Mills, The Cedars, Chislehurst, Kent
1905		Williams, Alan Herbert, 100, Church-road, Urmston, Lancs.
1862	Trans.	‖Williams, Charles Hanson Greville, F.R.S., Bay Cottage, Smallfields, near Horley, Surrey
1903		Williams, David John, Bath and West of England College of Chemistry and Pharmacy, 6, Cleveland-place, East Bath
1908		Williams, David Thomas, 42, Finsbury-square, E.C.
1895		Williams, Evan, Bradford-road Gas Works, Manchester
1905		Williams, Gerard William, c/o The Ida H. Gold Mining Co., viâ Laverton, Western Australia
1892		Williams, John, Government Laboratory, British Guiana

Date of Election.		
1908		Williams, Joseph Henry, 43, Prince's-road, Wimbledon, S.W.
1907	Proc.	Williams, Percy, B.Sc. (Lond.), c/o Wilhelmina Co., Pontianak, Dutch West Borneo
1883	Proc.	Williams, Rowland, F.I.C., Hale Cote, Albert-park, Lancaster
1891		Williams, Seward Whiting, c/o Messrs. Seabury and Johnson, East Orange, N.J., U.S.A.
1872		‖Williams, Thomas, Chemical Laboratory and Assay Office, 8, Victoria-street, Liverpool
1885	Trans.	‖Williams, Walter Collingwood, B.Sc. (Lond.), F.I.C., Beechfield, Roby, near Liverpool
1892		Williams, William, M.A., M.D., B.Ch., and D.P.H. (Oxon.), M.R.C.S. (Eng.), County Health Department, 9, The Parade, Cardiff; and Bryn Derw, 31, Victoria-road, Penarth
1899	Proc.	Williams, William Arthur, 36, Woodburn-terrace, Edinburgh
1874	Trans.	‖Williams, William Carleton, B.Sc. (Vict.), F.I.C., Broomgrove, Goring-on-Thames, Reading
1907		Williams, William Henry, Government Education Department, Hong Kong, China
1898		Williamson, John Alexander, The Croft, Chase Court-gardens, Enfield, Middlesex
1874	Trans.	‖Williamson, Robert, F.I.C., Messrs. Williamson and Corder, Ltd., Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Ph.D. (Munich), F.I.C., c/o The Cooper Research Laboratory, Berkhamsted, Herts.
1898		Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1907		Willott, David, B.Sc. (Lond.), Rosedale, Thorncroft-road, Sutton, Surrey
1896		Wills, Edward Chaning, M.A. (Cantab.), Rockstone, near Dawlish, S. Devon
1872		Wills, Joseph Lainson, 133, Midwood-street, Flatbush, Brooklyn, N.Y., U.S.A.
1906		Willstaetter, Richard, Prof., Ph.D. (Munich), Bergstrasse 25, Zürich V, Switzerland
1892	Trans.	Wilsmore, Norman Thomas Mortimer, D.Sc. (Melbourne), 126, Walm-lane, Willesden Green, N.W.
1885		Wilson, Alfred Charles, F.R.S.E., Borough Hall, Stockton-on-Tees
1879		‖Wilson, Charles Joseph, F.I.C., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, M.A. (Glas.), D.Sc., Carbeth, Killearn, Glasgow
1901		‖Wilson, Duncan, Broadwater Cross, Tunbridge Wells
1899	Proc.	Wilson, Frederick Robert Leyland, M.A. (Oxon.), Charterhouse, Godalming

Date of Election.		
1908		Wilson, Harry Percy, 3, Audley-road, Colchester
1875		‖Wilson, James, M.A. (Dub.), Barrister-at-Law, 2, Essex-court, Temple ; and 121, Claremont-road, Forest Gate, Essex
1878		‖Wilson, James Henry, F.I.C., 17, Cardigan-road, Richmond Hill, Surrey
1890		Wilson, James Mitchell, M.D. and C.M. (Glas.), D.P.H. (Cantab.), County Hall, Beverley
1901		Wilson, James Scott, M.D. and C.M. (Glas.), D.P.H. (Cantab.), Bradford-street, Walsall
1895	Proc.	Wilson, John, M.Sc. (Vict.), Battersea Polytechnic, S.W.
1899		Wilson, John, 153, Buckley-street, Footscray, Victoria, N.S.W.
1902		Wilson, Lyndon Charles, 31, Castle-gate, Newark-on-Trent
1900	Proc.	Wilson, Leonard Philip, 19, Widdrington-road, Coventry
1871		‖Wilson, William John, c/o Dr. W. M. Watts, Shirley, Venner-road, Sydenham, S.E.
1907		Wilson, William John, A.C.G.I., 12, Vicarage-park, Plumstead, Kent
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich, E.
1893		Winder, Edward Humphreys, Wetmore, Craven Arms, S.O., Salop.
1894		Wingate, Hamilton More, B.Sc. (Glas. and Melbourne), 71, Queenswood-road, Forest Hill, S.E.
1895		Wingfield, Thomas Rowland, 5, Bromwich-street, Bolton
1876		Winser, Percy James, F.I.C., Moor House, Biddulph Moor, Congleton
1906		Winther, Chr., M.Sc., Ostervold 5, Copenhagen, Denmark
1898	Trans.	Witham, Ernest, B.A., B.Sc. (Lond.), The Grammar School, Rotherham
1908		Withey, William Henry, B.A. (Cantab.), Walpole House, Church-road, Teddington, Middlesex
1876	Trans.	‖Witt, Otto Nikolaus, Geh. Rath Prof., Ph.D., Ebereschenallee 10, Westend bei Berlin, Germany
1906		Wolfe, Ernest Edwin, Kinsale, Co. Cork, Ireland
1907		Wolff, Mark Arthur, Poderosa Mining Co., c/o Messrs. H. A. Bethell & Co., Antofagasta, Chile, S. America
1902		Womersley, Charles Edward, 7, Tidswell-street, Heckmondwike, S.O., Yorks.
1889		Wood, Charles, Rossemount, Emm-lane, Heaton, Bradford
1860	Trans.	‖Wood, Charles Henry, F.I.C., Erica, Bournemouth-road, Parkstone, S.O., Dorset
1908		Wood, Francis Charles Benjamin, Deurne, near Antwerp, Belgium

Date of Election.		
1902		Wood, Frank Stanley, Chin Chu, Heathcote-street, Newland, Hull
1898	Trans.	Wood, Thomas Barlow, Prof., M.A. (Cantab.), Gonville and Caius College, Cambridge
1903		‖Wood, William Francis John, B.Sc. (Lond.), Hazelhurst, Doncaster-road, Barnsley
1884	Proc.	Wood, William Henry, B.A. (Oxon.), La Martinière, Calcutta
1900		Woodbridge, Walter Bourne, A.C.G.I., 36, Baker-street, Reading
1871	Trans.	Woodcock, Reginald C., F.I.C., The Sanitas Co., Ltd., Locksley-street, Limehouse, E.C.
1904		Woodcock, William Henry, 10, Chesson-road, W. Kensington, W.
1898		Woodhead, Samuel Allinson, B.Sc. (Dun.), F.I.C., Agricultural College, Uckfield, Sussex
1892		‖Woods, Hugh, B.A., M.D. and B.Ch. (Dub.), D.P.H., (R.C.P.S.I.), 31, Craven-street, Strand, W.C.
1888		Woodward, James, B.A., B.Sc. (Lond.), F.I.C., Drummond House, 31, Coventry-road, Ilford, Essex
1889		Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1903		Woolhouse, Sidney Herbert, M.A. and B.Sc. (Dub.), A.R.C.S.I., 5, Latymer-road, Lower Edmonton, N.
1889		Woosnam, Richard William, F.I.C., 1, The Chase, Warby Mount, Brentwood, Essex
1908	Trans.	Wootton, Hubert Arthur, B.A. (Cantab.), B.Sc. (Lond.), 20, Great College-street, Westminster, S.W.
1903		Worden, Edward Chauncey, M.A. (N.Y.), Clark Thread Co., Newark, N.J., U.S.A.
1884		‖Worrall, Jason Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858		‖Worsley, Philip John, Rodney Lodge, Clifton, Bristol
1906		Wortley, Edward Jocelyn, Rectory, Half-way-tree, Jamaica
1906	Trans.	Wren, Henry, M.A. (Oxon.), B.Sc. (Lond.), Ph.D. (Tübingen), 22, Stapleton-hall-road, Stroud Green, N.
1905		Wren, William James, A.R.C.S., Hilton College, near Maritzburg, Natal, S. Africa
1898		Wrench, Charles Arthur, 95A, Southwark-street, S.E.
1908		Wright, Charles Harold, B.A. (Cantab.), A.I.C., Government Laboratory, Port of Spain, Trinidad, British West Indies
1903		Wright, Fred., c/o Messrs. Elliott Bros., O'Connell-street, Sydney, N.S.W.
1895		Wright, Harold Edward, c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1878	Trans.	Wright, Lewis Thompson, 10, Linden-gardens, Bayswater, W.
1894		Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.	‖Wright, William Thomas, 11, Rundle-road, Sheffield
1864		‖Wrightson, John, Prof., College of Agriculture, Downton, Salisbury

Date of Election.			
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, William Fitzthomas, Wheatley-street, Coventry
1885	Trans.	C. 1892-6, S.1898-99, 1903-05, V.-P 1905-08.	‖Wynne, William Palmer, Prof., D.Sc. (Lond.), F.R.S., F.I.C., A.R.C.S., The University, and 17, Taptonville-road, Sheffield
1908			Yates, Harry James, Redcroft, Four Oaks, Warwickshire
1906			Yates, John William, B.Sc. (Lond.), A.R.C.S., 26, Studdridge-street, Fulham, S.W.
1908	Trans.		Yates, Joseph, Municipal Technical School, Blackburn
1886	Trans.		Yoshida, Hikorokurō, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred Collett, 17, Vicar's-hill, Lewisham, S.E.
1903			Young, Andrew, M.A. and B.Sc. (Edin.), Geological Department, South African College, and 5, Rosmead-avenue, Cape Town, S. Africa
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1908	Trans.		Young, Charles Robert, B.Sc. (Lond.), 11, Low-pavement, Nottingham
1897			Young, Francis Samuel, M.A. (Oxon.), F.I.C., The College, Bishop's Stortford
1877			‖Young, Frank Watson, F.R.S.E., 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D. (Erlangen), 79, Harvard-court-mansions, Honeybourne-road, West Hampstead, N.W.
1895			Young, Henry Stow, F.I.C., c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 12, Edge-hill, Plumstead, Kent
1874			Young, John, 164, Bath-street, Glasgow
1898			Young, John Henry, B.Sc. (Vict.), c/o Cassel Gold Extracting Co., Ruchill-road, Maryhill, Glasgow
1877			‖Young, John Rymer, 21, Palmyra-square, Warrington
1887	Trans.		Young, John William, B.A. and B.Sc. (Lond.), 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc. (Lond.), B.Sc. (Manc.), Hon. Sc.D. (Dub.), F.R.S., F.I.C., Trinity College, Dublin
1902			Young, Thomas Arthur, 11, Hampshire-street, Cheetham, Manchester
1907			Young, Walter Ormston, 14, Normanton-terrace, Newcastle-on-Tyne

Date of Election			
1873			‖Young, William Charles, F.I.C., 2, Queen Anne's-grove, Bedford Park, W. ; and Chemical Laboratory, 19/20, Aldgate, E.C.
1907	Trans.		Zortman, Israel Hyman, B.Sc. (Vict.), Ph.D. (Leipzig), 13, Skinner-lane, Leeds

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Number of Honorary and Foreign Members ...	35
,, ,, Fellows	2929

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